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SR-1447 Fracture Mechanics Characterization of Aluminum Alloys for Marine Structural Applications

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FTA # SSC 10624-01
Contract Number: W7707-053033/001/HAL
Contract Scientific Authority: Dr. Leon Cheng, 902-427-2601
Defence Scientist, Emerging Materials Section

Defence R&D Canada – Atlantic

Contract Report
DRDC Atlantic CR 2007-019
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Canada

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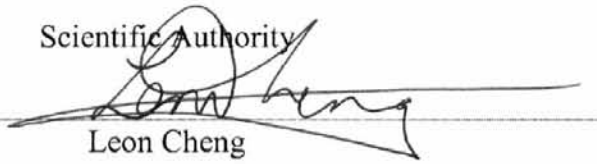

Leon Cheng

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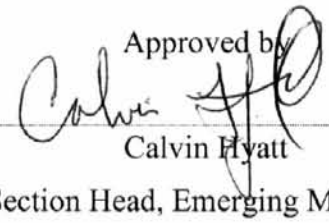

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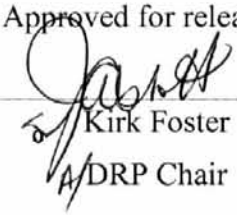

Kirk Foster

A/DRP Chair

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Abstract

The Ship Structure Committee (SSC) identified a lack of information required for structural integrity and damage tolerance analyses of aluminum marine structures. The development of such data is vital in light of the increased use of aluminum alloys in marine construction. Under SSC project SR-1447, Fracture Technology Associates was contracted to characterize, through experimental fracture mechanics, the fatigue crack growth (FCG) resistance and fracture toughness of three aluminum alloys (5083, 5086, 5383) used in marine structural applications. Fatigue crack growth testing was performed following ASTM Standard E 647-00 in laboratory air at room temperature and in simulated ocean water per ASTM Standard D 1141. Non-linear fracture toughness testing was performed in accordance with ASTM Standard E 1820-01 in laboratory air at room temperature. For the three different grades of material, the difference in fatigue crack growth rate in laboratory air was negligible. In simulated seawater environment, AA5086 showed a slightly superior performance. In addition, all samples showed the same ranking of toughness with the 5086 showing the highest toughness, followed by 5083 and then 5383.

Résumé

Le Comité sur la structure des navires (CSN) a identifié des lacunes dans l'information requise pour l'analyse de l'intégrité structurale et de la tolérance aux avaries des structures maritimes en aluminium. Le développement de ces données est vital en ce sens que l'on utilise de plus en plus les alliages d'aluminium dans la construction maritime. Dans le cadre du projet SR-1447 du SSC, on a donné un contrat à la société *Fracture Technology Associates* pour qu'elle caractérise, grâce à des expériences de mécanique de la rupture, la résistance à la propagation des fissures en fatigue (PFF) et la ténacité (résistance à la propagation brutale de fissures) de trois alliages d'aluminium (5083, 5086, 5383) utilisés dans des applications structurales maritimes. Des essais sur la propagation des fissures en fatigue ont été réalisés, conformément à la norme ASTM Standard E 647-00, hors de l'eau et en laboratoire, à la température ambiante, ainsi que dans un milieu marin simulé en suivant la norme ASTM Standard D 1141. Des essais sur la résistance à la propagation de fissures non linéaires ont été réalisés, conformément à la norme ASTM Standard E 1820-01, hors de l'eau et en laboratoire, à la température ambiante. Pour les trois nuances d'alliages différentes, la différence dans le taux de propagation des fissures en laboratoire et hors de l'eau était négligeable. Dans le milieu marin simulé, l'alliage AA5086 a démontré une performance légèrement supérieure. En outre, tous les échantillons se sont situés à l'intérieur de la même plage de ténacité, l'alliage 5086 étant le plus résistant, suivi de l'alliage 5083, puis de l'alliage 5383.

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Executive summary

Introduction

As part of a Ship Structure Committee (SSC) project (Project SR-1447), Fracture Technology Associates was contracted to characterize, through experimental fracture mechanics, the fatigue crack growth (FCG) resistance and fracture toughness of three aluminum alloys (5083, 5086, 5383) used in marine structural applications. AA5083 is one of the aluminum alloys most widely used for the plate components of high-speed craft. Although 5083 performs well in its marine applications, it was not developed specifically for this environment and 5383 was specifically developed to help optimize aluminum behavior in the marine environment.

Significance

The Ship Structure Committee identified a lack of information required for structural integrity and damage tolerance analyses of aluminum marine structures. To acquire such information requires the characterization of fatigue crack growth resistance and fracture toughness through experimental fracture mechanics. The development of such data is vital in light of the increased use of aluminum alloys in marine construction.

Results

Fatigue crack growth rate and fracture toughness testing were conducted on the three grades of aluminum alloys. The fatigue crack growth testing was performed following ASTM Standard E 647-00 in laboratory air at room temperature and in simulated ocean water per ASTM Standard D 1141. Non-linear fracture toughness testing was performed in accordance with ASTM Standard E 1820-01 in laboratory air at room temperature.

For the three different grades of material, the difference in fatigue crack growth rate in laboratory air is negligible. In simulated seawater environment, AA5086 shows a slightly superior performance. In addition, all samples show the same ranking of toughness with the 5086 showing the highest toughness, followed by 5083 and then 5383.

Donald, J.K., Blair, A. 2007. SR-1447 Fracture Mechanics Characterization of Aluminum Alloys for Marine Structural Applications. DRDC Atlantic CR 2007-019. Defence R&D Canada – Atlantic.

Sommaire

Introduction

Dans le cadre d'un projet du SSC (Comité sur la structure des navires) (le projet SR-1447), on a donné un contrat à la société *Fracture Technology Associates* pour qu'elle caractérise, grâce à des expériences de mécanique de la rupture, la résistance à la propagation des fissures en fatigue (PFF) et la ténacité (résistance à la propagation brutale de fissures) de trois alliages d'aluminium (5083, 5086, 5383) utilisés dans des applications structurales maritimes. L'alliage AA5083 est l'un des alliages d'aluminium les plus couramment utilisés pour fabriquer des composants de plaques pour des embarcations rapides. Bien que l'alliage 5083 se comporte bien dans les applications maritimes, il n'a pas été mis au point spécifiquement pour ce milieu, alors que l'alliage 5383 a été spécifiquement élaboré pour optimiser le comportement de l'aluminium dans le milieu marin.

Portée

Le Comité sur la structure des navires (CSN) a identifié des lacunes dans l'information requise pour l'analyse de l'intégrité structurale et de la tolérance aux avaries des structures maritimes en aluminium. Pour obtenir ces renseignements, on doit caractériser la résistance à la propagation des fissures en fatigue (PFF) et la ténacité (résistance à la propagation brutale de fissures) par des expériences de mécanique de la rupture. L'élaboration de ces données est vitale en raison de l'utilisation de plus en plus grande des alliages d'aluminium dans la construction maritime.

Résultats

Des essais portant sur le taux de propagation des fissures en fatigue et sur la ténacité de trois nuances d'alliages d'aluminium ont été réalisés. Des essais sur la propagation des fissures en fatigue ont été réalisés, conformément à la norme ASTM Standard E 647-00, hors de l'eau et en laboratoire, à la température ambiante, ainsi que dans un milieu marin simulé en suivant la norme ASTM Standard D 1141. Des essais sur la résistance à la propagation de fissures non linéaires ont été réalisés, conformément à la norme ASTM Standard E 1820-01, hors de l'eau et en laboratoire à la température ambiante.

Pour les trois nuances d'alliages différentes, la différence dans le taux de propagation des fissures en laboratoire et hors de l'eau était négligeable. Dans le milieu marin simulé, l'alliage AA5086 a démontré une performance légèrement supérieure. En outre, tous les échantillons se sont situés à l'intérieur de la même plage de ténacité, l'alliage 5086 étant le plus résistant, suivi de l'alliage 5083, puis de l'alliage 5383.

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1. Chemistry and Mechanical Properties

1.1 Introduction

The following alloys were procured as 0.5 inch thick plates measuring 24 x 24 inches.

5083 H321 supplied as 5083 H321
5086 H116 supplied as 5086 H32 (to ASTM B209)
5383 H116 supplied as 5383/5083 H116 (to ASTM B209-01)

Dr. Harold Reemsnyder provided a detailed summary in Annex A.

Dr. Catherine Wong provided metallography analysis on the procured alloys (See Annex A).

Dirats Laboratories was contracted to provide the following services:

1. 3 chemical analysis (one for each alloy)

2. 18 tensile test results (three alloys, 2 orientations, triplicate tests)

3. 15 compact tension samples for fatigue crack growth rate testing (T-L orientation, five per alloy)

4. 9 compact tension samples for non-linear fracture toughness testing (T-L orientation, three per alloy)

1.2 Test Results

Table 1 summarizes the chemical analysis for each alloy.

Table 1. *Summary of Chemical Analysis.*

Test ID	Material	Al %	Cr %	Cu %	Fe %	Mg %	Mn %	Si %	Ti %	Zn %	Zr %
5083-C-1	5083-H321	Rem.	0.08	0.06	0.31	4.82	0.50	0.15	0.03	0.09	--
5086-C-1	5086-H116	Rem.	0.19	0.07	0.31	3.79	0.45	0.14	0.03	0.03	--
5383-C-1	5383-H116	Rem.	0.10	0.06	0.29	4.76	0.53	0.13	0.03	0.08	0.01

Table 2 summarizes the mechanical properties for each alloy.

Table 2. *Summary of Mechanical Properties.*

Test ID	Material	Orientation	0.2%Yield Strength (ksi)	Tensile Strength (ksi)	Elongation %	Reduction of Area %
5083-L-1	5083-H321	L	37.8	52.3	12.1	21.1
5083-L-2	5083-H321	L	37.8	53.0	14.3	20.5
5083-L-3	5083-H321	L	38.2	52.8	16.8	22.4
Average			**37.9**	**52.7**	**14.4**	**21.3**
5083-T-1	5083-H321	T	34.3	52.0	21.5	36.9
5083-T-2	5083-H321	T	34.4	51.6	19.0	34.6
5083-T-3	5083-H321	T	34.3	51.8	18.4	36.8
Average			**34.3**	**51.8**	**19.6**	**36.1**
5086-L-1	5086-H116	L	27.0	45.8	14.8	17.4
5086-L-2	5086-H116	L	26.9	45.7	15.1	16.8
5086-L-3	5086-H116	L	27.0	46.0	15.3	16.1
Average			**27.0**	**45.8**	**15.1**	**16.8**
5086-T-1	5086-H116	T	27.0	45.7	17.1	27.4
5086-T-2	5086-H116	T	26.9	46.2	21.1	36.6
5086-T-3	5086-H116	T	27.1	46.1	19.9	38.7
Average			**27.0**	**46.0**	**19.4**	**34.2**
5383-L-1	5383-H116	L	39.3	54.4	14.1	16.2
5383-L-2	5383-H116	L	39.2	54.1	14.4	17.2
5383-L-3	5383-H116	L	39.0	54.0	12.9	15.6
Average			**39.2**	**54.2**	**13.8**	**16.3**
5383-T-1	5383-H116	T	35.4	53.0	17.5	35.0
5383-T-2	5383-H116	T	35.4	53.5	16.4	24.8
5383-T-3	5383-H116	T	35.5	53.3	18.1	23.3
Average			**35.4**	**53.3**	**17.3**	**27.7**
Temperature: Room Temperature						

2. Fatigue Crack Growth Rate Characterization

2.1 Introduction

Fatigue crack growth rate (FCGR) testing was conducted on three grades of aluminum alloys designated 5083-H321, 5086-H116 and 5383-H116. A compact tension sample having a width of 4.000 inches and a thickness of 0.500 inches was chosen for all FCGR testing. For each grade of material, two replicate tests were conducted in laboratory air at room temperature and two replicate tests were conducted in simulated ocean water per ASTM Standard D 1141. All samples were machined in the T-L orientation and all testing was conducted using a stress ratio (R) of 0.1. A baseline test frequency of 10 Hz was selected for the laboratory air tests with a baseline frequency of 5 Hz selected for the tests conducted in seawater. Some data were generated in seawater at 0.5 and 0.05 Hz to evaluate frequency sensitivity. The testing was performed in accordance with the requirements of ASTM E647-00 "Standard Test Method for Fatigue Crack Growth Rates". Background information on the methodology for testing and analysis is given in Annex B.

2.2 Test Equipment

The tests were conducted on two MTS load frames equipped with a 5,000 lbf load cell. Each test frame and controller was interfaced to an Adwin-Gold FTA computer system. The crack length was monitored continuously using the compliance technique enabling the stress intensity to be precisely controlled as a function of crack length. An MTS model 632.03E-20 clip gage with a gage length of 0.475 inches and a working range of 0.100 inches was used for displacement measurement. Fixture alignment was verified for the compact tension clevises by applying a force on a dummy sample and measuring the distance between the loading pins on the front face and back face of the clevis. If the spacing differed by more than 0.001 inches, the clevises were shimmed to bring that difference to within tolerance. Compliance measurement accuracy was enhanced by mounting needle bearings in both the clevis holes and the specimen holes to minimize non-linearity in the load-displacement signal due to pin friction. In addition to improving the accuracy of crack growth measurements, this procedure is considered essential for accurate crack closure measurement. Laboratory temperature and relative humidity were controlled to 75°F ±2°F and 40% ±5% R.H. throughout the entire period of testing. Photographs of the test equipment and a close-up of a compact tension sample and test fixtures are shown in Figure 1.

For the synthetic seawater environment, one gallon of distilled water was combined with a sea-salt mix according to the ASTM D 1141 standard. A peristaltic pump was used to aerate the solution and transfer the environment to the test sample. Custom made clear plastic environment chambers were attached to the test sample with silicon

adhesive. These chambers were attached to the sample 24 hours prior to testing to allow a complete cure of the adhesive. A small hole was drilled in the notch to provide flow from one side of the sample to the other. A larger hole was also drilled in the notch and filled with sealant to provide a water-tight seal. The set-up included an air bleed so that the crack remained fully immersed in solution during the entire test. pH readings were recorded daily with a typical range of 8.4 to 7.8. Photographs of the test set-up for the seawater environment are shown in Figure 2.

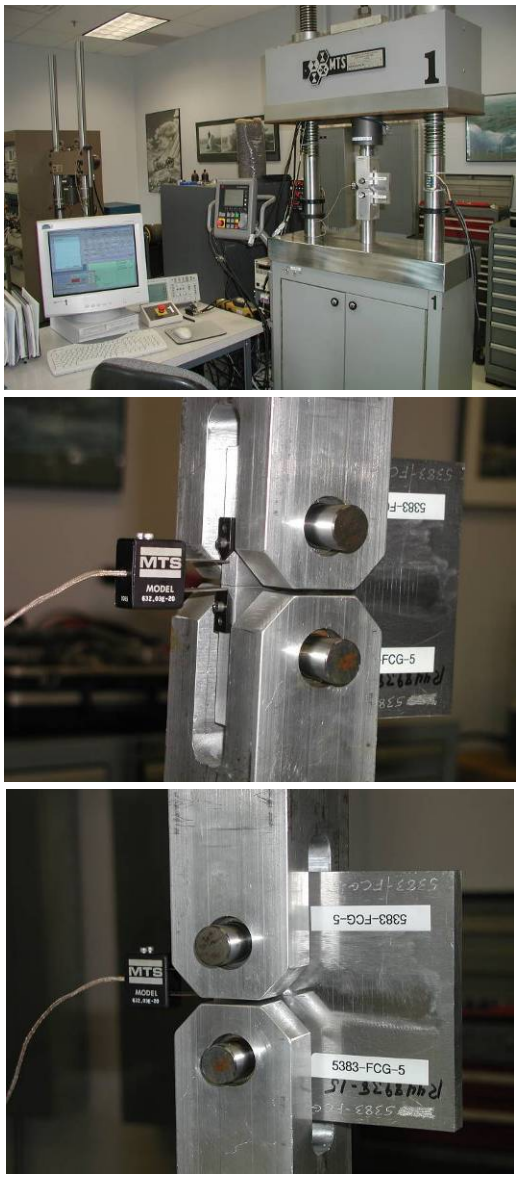

Figure 1. *Photographs of test equipment and test set-up (laboratory air environment).*

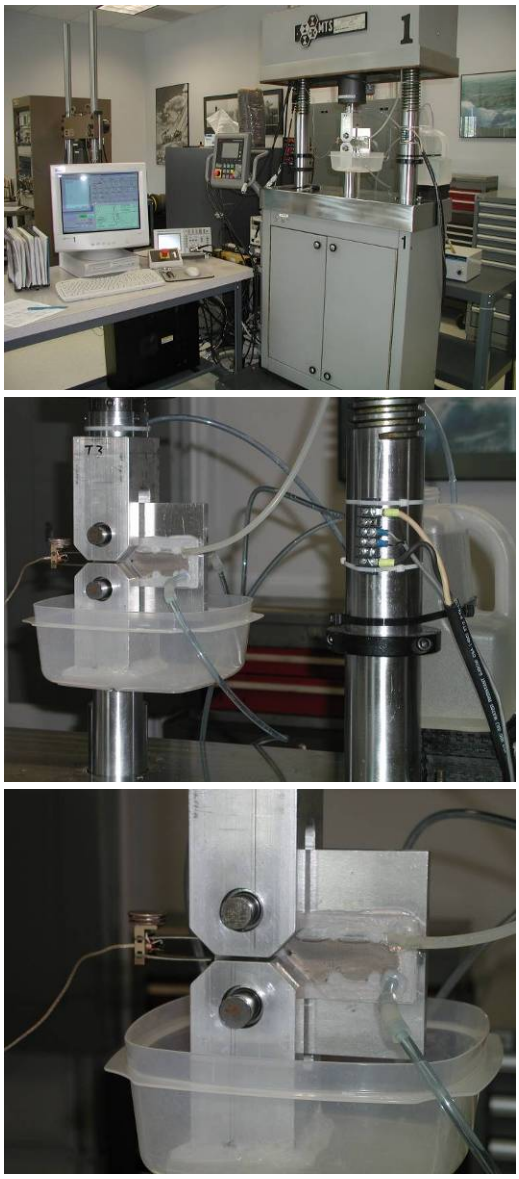

Figure 2. *Photographs of test equipment and test set-up (seawater environment).*

2.3 Sample Preparation

The test samples were machined according to Figure 3. After machining the blanks to the final dimensions, but before machining the notch, reference scribes were placed on the edge of the sample spanning the location of the notch. The distance between these scribes was measured to a precision of ±0.0001 inches, both before and after machining the notch. This information was used to estimate the magnitude of residual

K at the notch tip due to residual stress. A summary of these calculations is shown in Table 3 (Section 2.5).

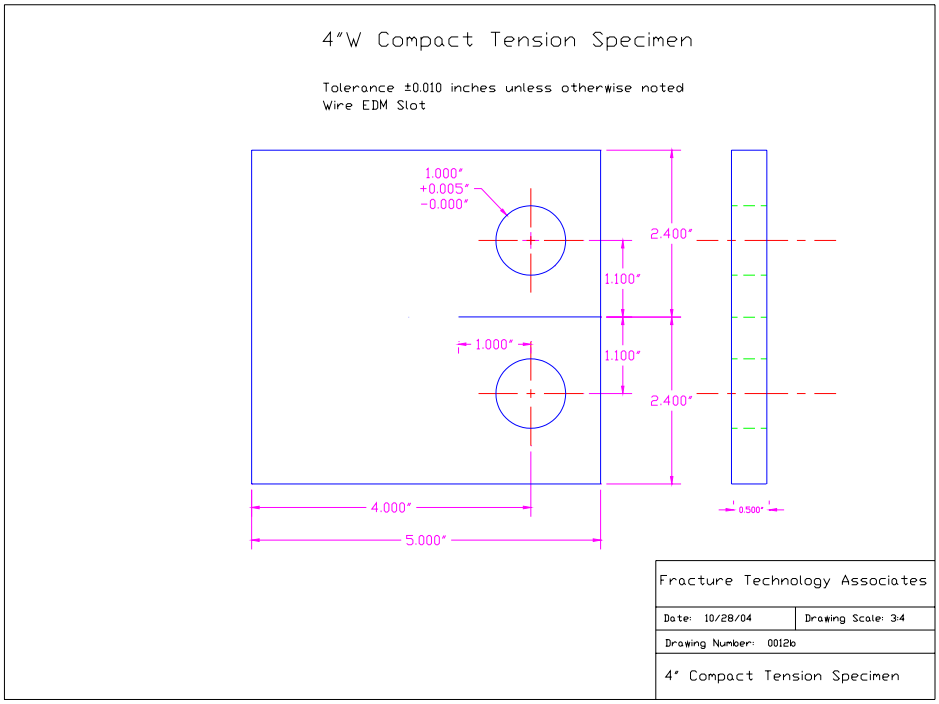

Figure 3. *Diagram of C(T) sample for fatigue crack growth testing (diagram reproduction not to scale).*

2.4 Test Procedure

The pre-cracking was initiated at low values of K_{max} (~ 4 ksi$\sqrt{in}$) in order to initiate a crack at low growth rates. Once initiation was detected and crack evenness was verified, the pre-cracking was continued using a decreasing K-gradient of -4.0 1/inch until a crack growth rate of ~8 x 10^{-8} inch/cycle was achieved. At the completion of pre-cracking, the test was switched to an increasing K-gradient of +4.0 1/inch and continued at that K-gradient until a crack growth rate of 1 x 10^{-5} inch/cycle. A shallower K-gradient of +2.0 1/in was selected for upper region II (up to 1 x 10^{-4} inch/cycle). Region III crack growth rate data were generated under constant amplitude loading.

Periodic visual measurements of the crack length from each surface were recorded. These measurements, along with the corresponding normalized compliance (EvB/P), were entered into the post-test analysis software to correct for any discrepancy between the physical crack length and the compliance calculated crack length. The

cover page of each test (Annex E) includes a summary of errors between the physical and compliance calculated crack length as well as an adjustment factor (CAF) to the modulus of elasticity to minimize these errors. Compliance coefficients were selected from the ASTM E647 standard based on a clip gage location at the edge of the sample.

For the near-threshold tests, crack growth rate data were generated using a decreasing K-gradient of -4.0 1/inch and continued until crack growth rates were less than ~4 x 10^{-9} inch/cycle. After establishing threshold, the tests were continued using an increasing K-gradient of +4.0 1/inch and continued at that K-gradient until a crack growth rate of 1 x 10^{-5} inch/cycle. Both decreasing and increasing K data were generated in laboratory air at a cyclic test frequency of 24 Hz.

During testing, the FTA testing software calculated the effective stress intensity according to the ASTM opening load method. However, another methodology for determining the effective stress intensity was also used and is called the adjusted compliance ratio (ACR) method. Crack growth rates are computed using a combination of the modified secant method and the seven point incremental polynomial technique. The first method is computed as follows:

$$da/dN = (a_{i+2}-a_i)/(N_{i+2}-N_i) \quad (1)$$

and

$$a_{average} = (a_{i+2}+a_i)/2 \quad (2)$$

The second method is thoroughly described in Appendix X1 of ASTM E647. This method smoothes the data but misses three points at the beginning and three points at the end of the data set. The combined methods use the seven-point method for the bulk of the data with the modified secant method used for the “missed” points in the beginning and end of the data set.

2.5 Test Results and Discussion

Table 3 summarizes the calculation of K residual at the notch tip using the restoring force model. Table 4 summarizes key test conditions and the cyclic stress intensity at threshold (ΔK_{th}). Threshold determinations were made by applying the data fit as per ASTM E647.

The results of the K residual evaluation (Table 3) showed mostly tensile residual stress at the notch tip. However, the magnitude of the residual stress was small so no attempt was made to account for residual stress in the analysis.

All samples met the crack front evenness requirement according to ASTM E647. All other validity requirements were satisfied as well.

The following files are available.

***.dat files:**

This file is produced by the analysis software and can be exported to Excel or Grapher for plotting or further analysis. For each data point, the following variables are tabulated:

Description	Units
Index number	
Maximum force	(lbf)
Cyclic force	(lbf)
Normalized compliance	(EvB/P)
Crack length	(in)
Cycle count	
Crack growth rate	(inch/cycle)
K_{max}	(ksi$\sqrt{}$in)
$\Delta K_{applied}$	(ksi$\sqrt{}$in)
$\Delta K_{effective}$ (2% offset opening load method)	(ksi$\sqrt{}$in)
$\Delta K_{effective}$ (ACR method)	(ksi$\sqrt{}$in)
$\Delta K_{effective}$ (2/π partial closure method)	(ksi$\sqrt{}$in)

***.prn files:**

These files include tabular results and additional information such as sample dimensions and visual observation (Annex E).

Table 3. *Estimation of K Residual Using Restoring Force Model.*

Test ID	Notch Mouth Displacement Change (inches)	$K_{residual}$ (ksi√in)
5083-1	+0.0002	+0.12
5083-2	+0.0001	+0.06
5083-3	+0.0004	+0.24
5083-4	+0.0004	+0.24
5083-5	+0.0001	+0.06
5086-1	+0.0002	+0.12
5086-2	+0.0000	+0.00
5086-3	+0.0002	+0.12
5086-4	+0.0001	+0.06
5086-5	+0.0000	+0.00
5383-1	+0.0000	+0.00
5383-2	+0.0001	+0.06
5383-3	+0.0000	+0.00
5383-4	-0.0001	-0.06
5383-5	+0.0001	+0.06

Table 4. *Summary of Fatigue Crack Growth Test Conditions and Results (Temperature: 75°F, Stress Ratio: 0.1, Orientation: T-L).*

Test ID	Material	Environment	K-Gradient (1/in)	Frequency (Hz)	ΔK_{th} (ksi√in)
5083-1B	5083-H321	Air	+4.0	10.0	--
5083-1C	5083-H321	Air	+2.0	10.0	--
5083-1D	5083-H321	Air	Constant Load	5.0	--
5083-2B	5083-H321	Air	+4.0	10.0	--
5083-2C	5083-H321	Air	+2.0	10.0	--
5083-2D	5083-H321	Air	Constant Load	5.0	--
5083-3B	5083-H321	Seawater	+4.0	5.0	--
5083-3C	5083-H321	Seawater	+2.0	5.0	--
5083-3D	5083-H321	Seawater	Constant Load	5.0	--
5083-4B	5083-H321	Seawater	+4.0	5.0, 0.5	--
5083-4C	5083-H321	Seawater	+2.0	5.0, 0.5, 0.05	--
5083-4D	5083-H321	Seawater	Constant Load	5.0, 0.5, 0.05	--
5083-5A	5083-H321	Air	-4.0	24.0	2.64
5083-5B	5083-H321	Air	+4.0	24.0	--
5086-1B	5086-H116	Air	+4.0	10.0	--
5086-1C	5086-H116	Air	+2.0	10.0	--
5086-1D	5086-H116	Air	Constant Load	5.0	--
5086-2B	5086-H116	Air	+4.0	10.0	--
5086-2C	5086-H116	Air	+2.0	10.0	--
5086-2D	5086-H116	Air	Constant Load	5.0	--
5086-3B	5086-H116	Seawater	+4.0	5.0	--
5086-3C	5086-H116	Seawater	+2.0	5.0	--
5086-3D	5086-H116	Seawater	Constant Load	5.0	--

Table 4. *Summary of Fatigue Crack Growth Test Conditions and Results (continued).*

Test ID	Material	Environment	K-Gradient (1/in)	Frequency (Hz)	ΔK_{th} (ksi$\sqrt{in}$)
5086-4B	5086-H116	Seawater	+4.0	5.0, 0.5	--
5086-4C	5086-H116	Seawater	+2.0	5.0, 0.5, 0.05	--
5086-4D	5086-H116	Seawater	Constant Load	5.0, 0.5, 0.05	--
5086-5A	5086-H116	Air	-4.0	24.0	3.01
5086-5B	5086-H116	Air	+4.0	24.0	--
5383-1B	5383-H116	Air	+4.0	10.0	--
5383-1C	5383-H116	Air	+2.0	10.0	--
5383-1D	5383-H116	Air	Constant Load	5.0	--
5383-2B	5383-H116	Air	+4.0	10.0	--
5383-2C	5383-H116	Air	+2.0	10.0	--
5383-2D	5383-H116	Air	Constant Load	5.0	--
5383-3B	5383-H116	Seawater	+4.0	5.0	--
5383-3C	5383-H116	Seawater	+2.0	5.0	--
5383-3D	5383-H116	Seawater	Constant Load	5.0	--
5383-4B	5383-H116	Seawater	+4.0	5.0, 0.5	--
5383-4C	5383-H116	Seawater	+2.0	5.0, 0.5, 0.05	--
5383-4D	5383-H116	Seawater	Constant Load	5.0, 0.5, 0.05	--
5383-5A	5383-H116	Air	-4.0	24.0	2.67
5383-5B	5383-H116	Air	+4.0	24.0	--

A series of plots have been prepared to facilitate the investigation of reproducibility, environment, material, frequency, threshold and crack closure.

2.5.1 Reproducibility

Figures 4 through 9 show duplicate test results in both laboratory air and seawater for each grade of material. Agreement is excellent within identical test conditions. For simplicity, the comparisons among the various materials, environments, etc. are made with only one of the duplicate tests.

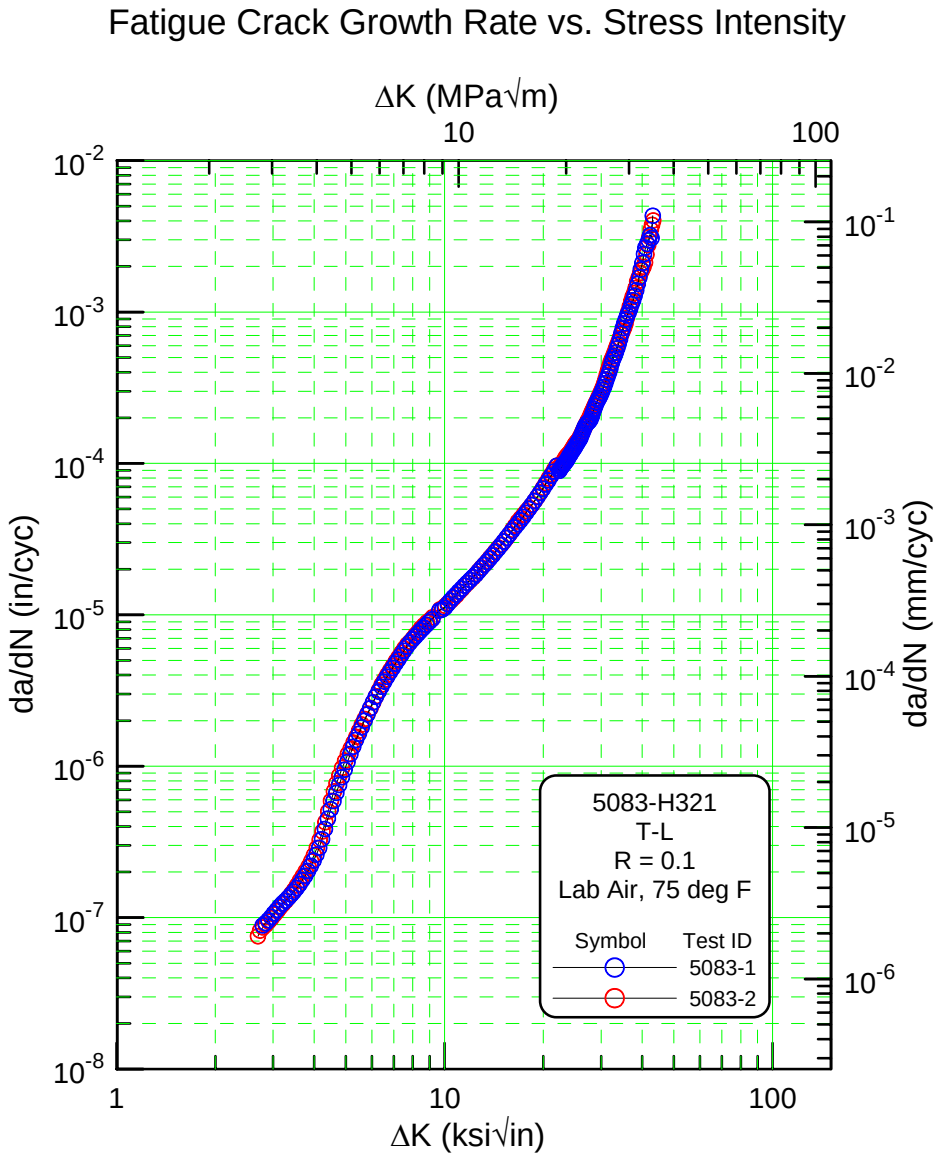

Figure 4. *FCGR response comparing duplicate tests for the 5083-H321 alloy in laboratory air.*

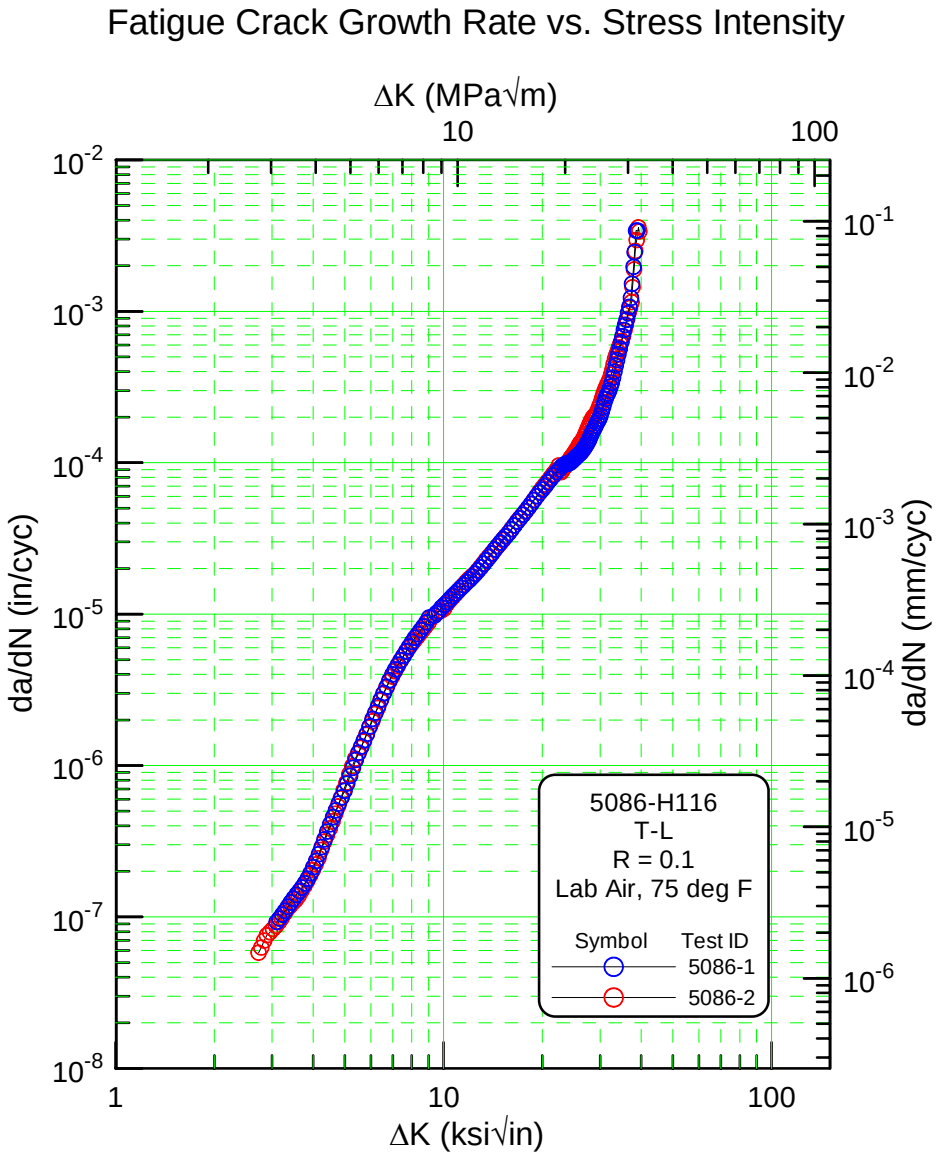

Figure 5. *FCGR response comparing duplicate tests for the 5086-H116 alloy in laboratory air.*

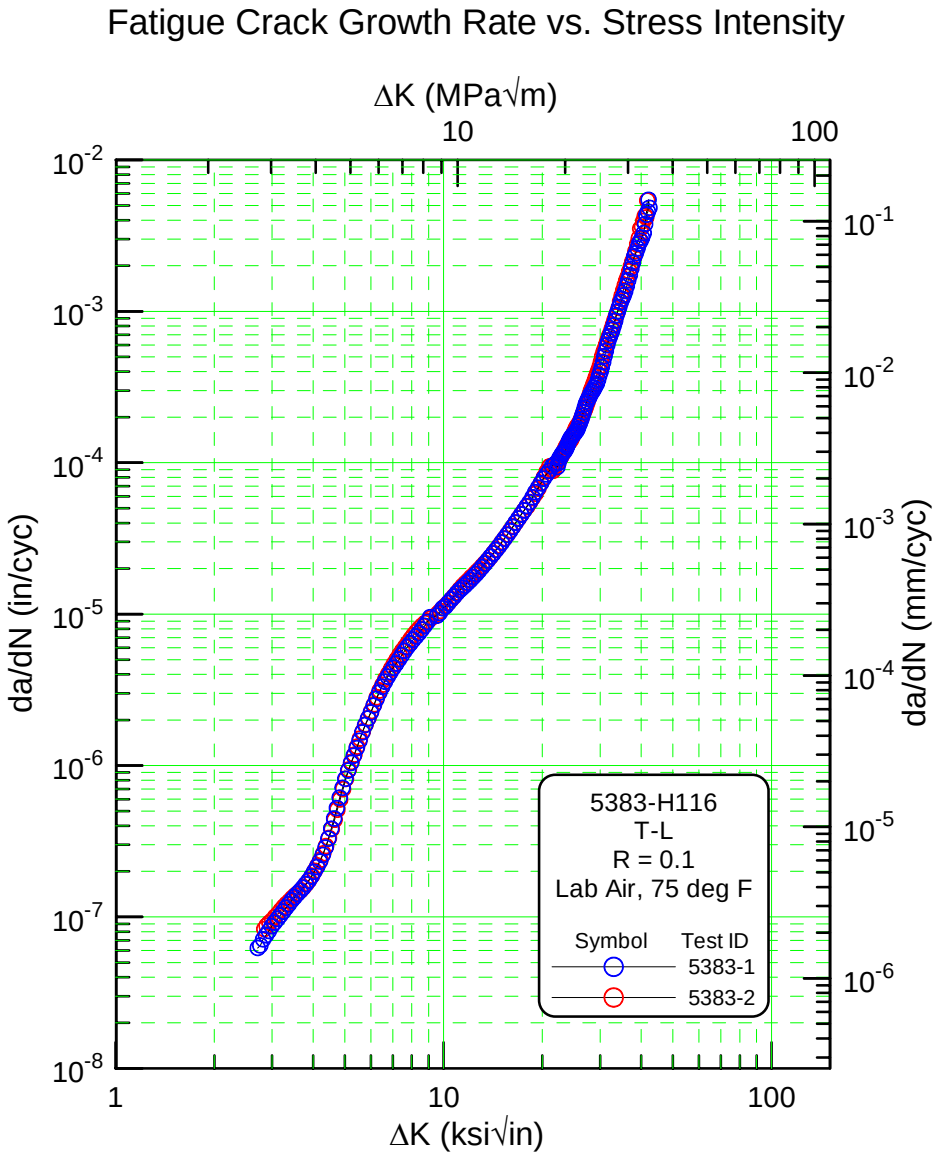

Figure 6. *FCGR response comparing duplicate tests for the 5383-H116 alloy in laboratory air.*

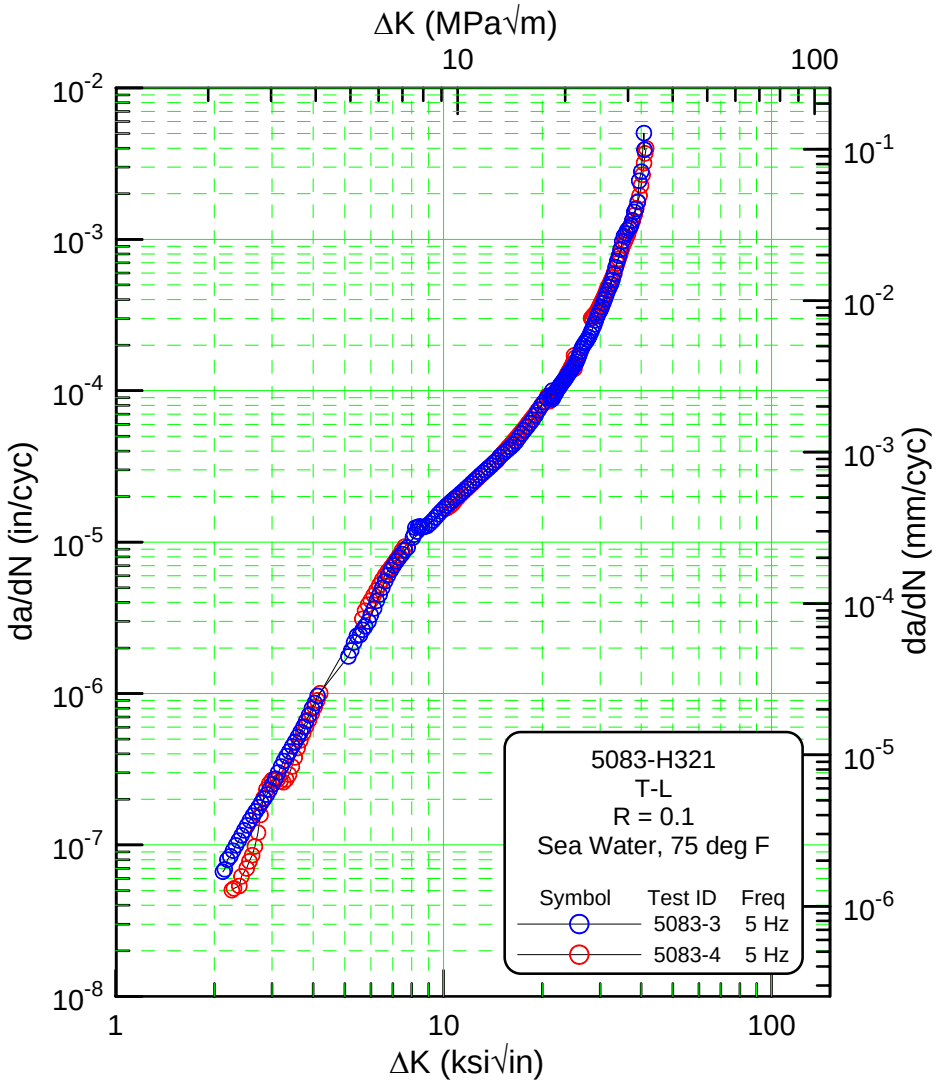

Figure 7. *FCGR response comparing duplicate tests for the 5083-H321 alloy in seawater.*

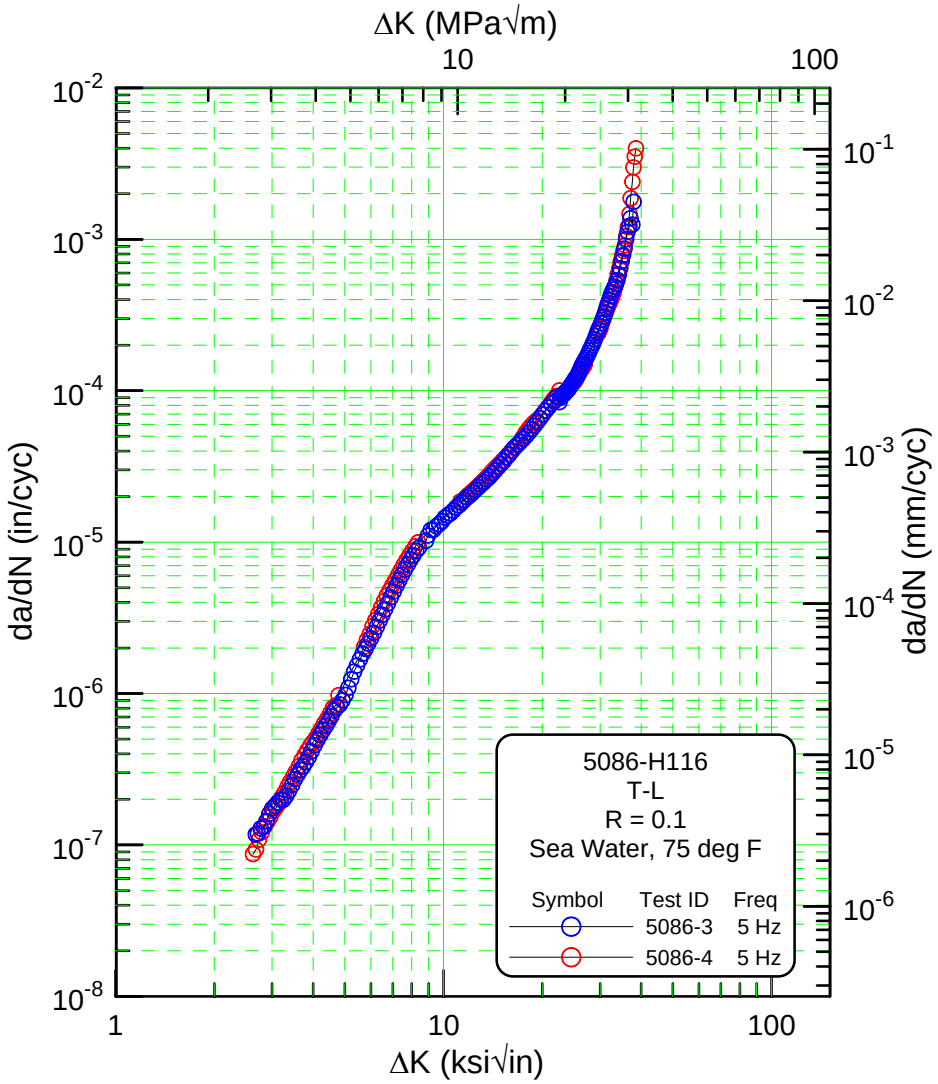

Figure 8. *FCGR response comparing duplicate tests for the 5086-H116 alloy in seawater.*

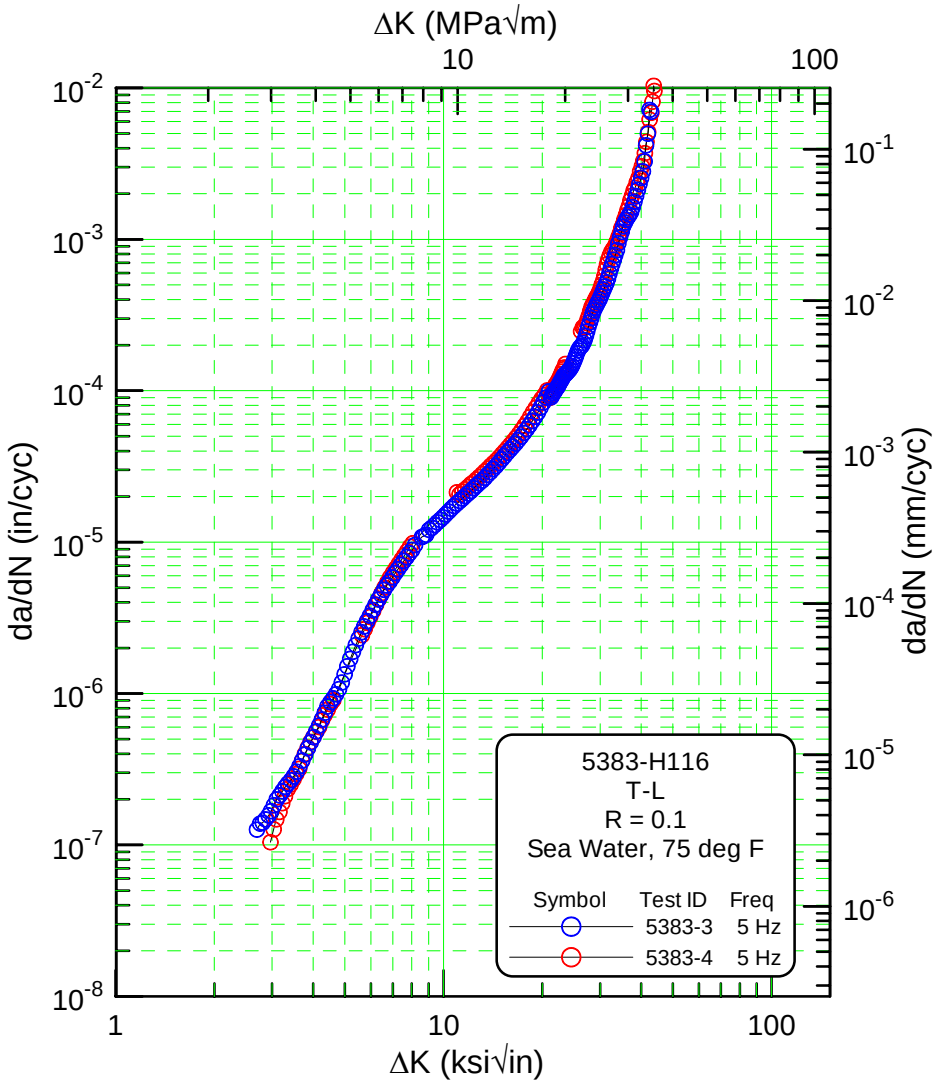

Figure 9. *FCGR response comparing duplicate tests for the 5383-H116 alloy in seawater.*

2.5.2 Effect of Environment

Figures 10 through 12 show the effect of environment for each grade of material. The impact is greater at lower growth rates. The crack growth rates may be too fast at the higher growth rates for significant environmental effects. It appears that the environmental effect is greater with the 5083-H321 and 5383-H116 alloys.

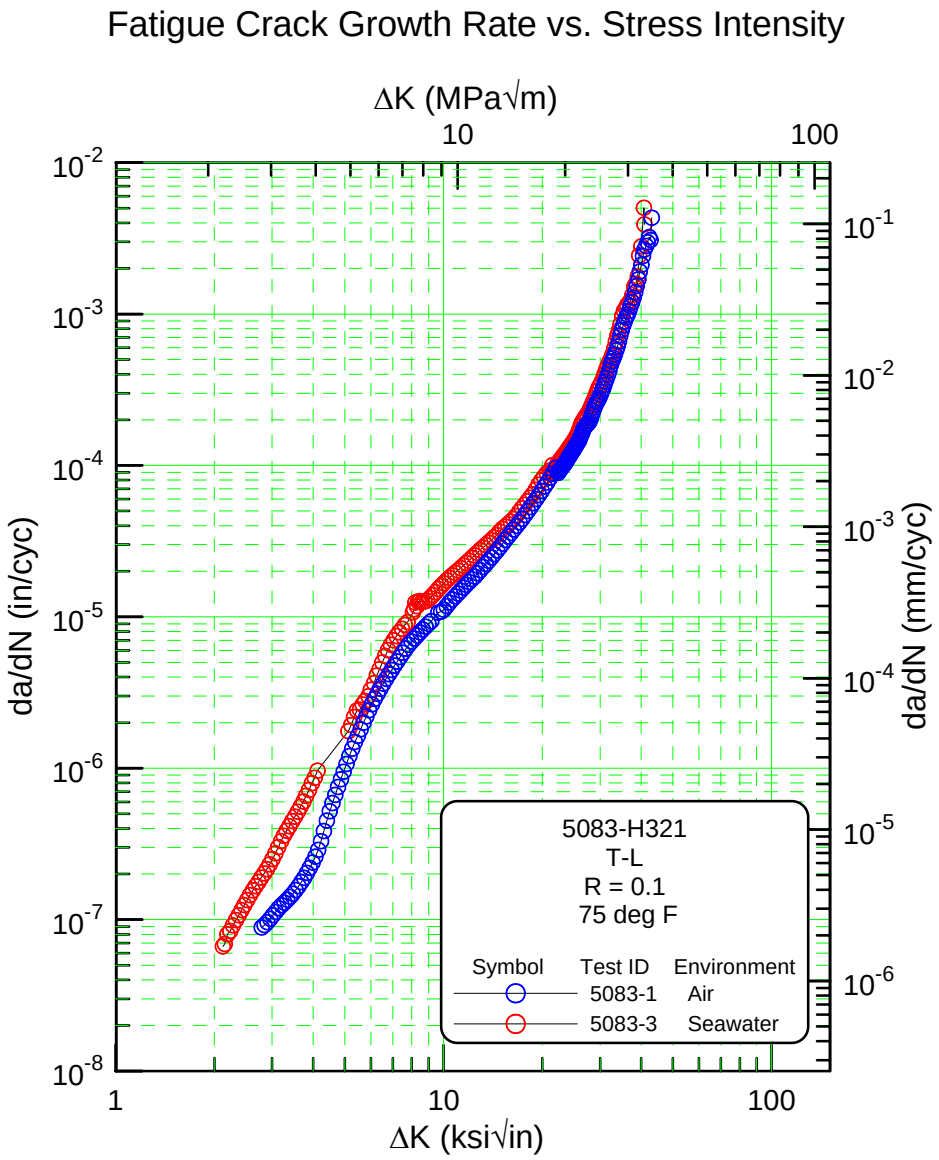

Figure 10. *FCGR response showing the effect of environment for the 5083-H321 alloy.*

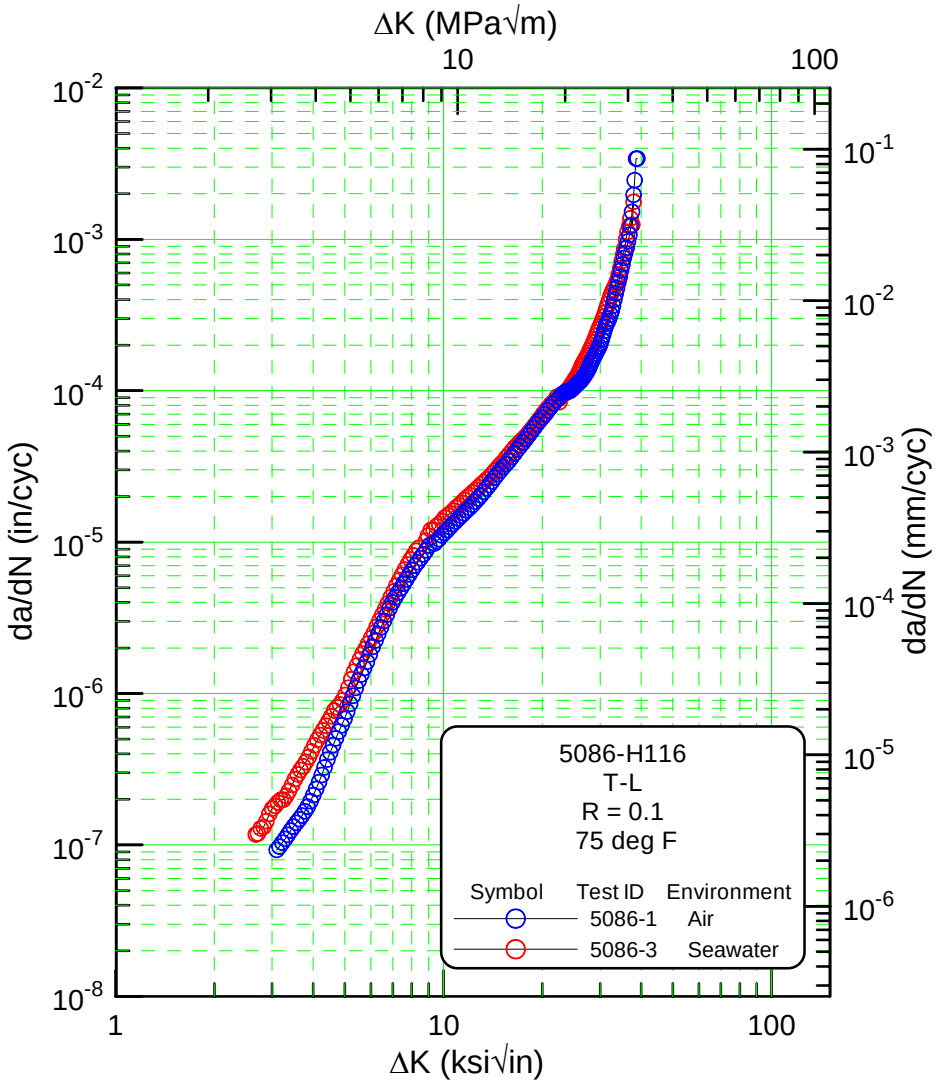

Figure 11. *FCGR response showing the effect of environment for the 5086-H116 alloy.*

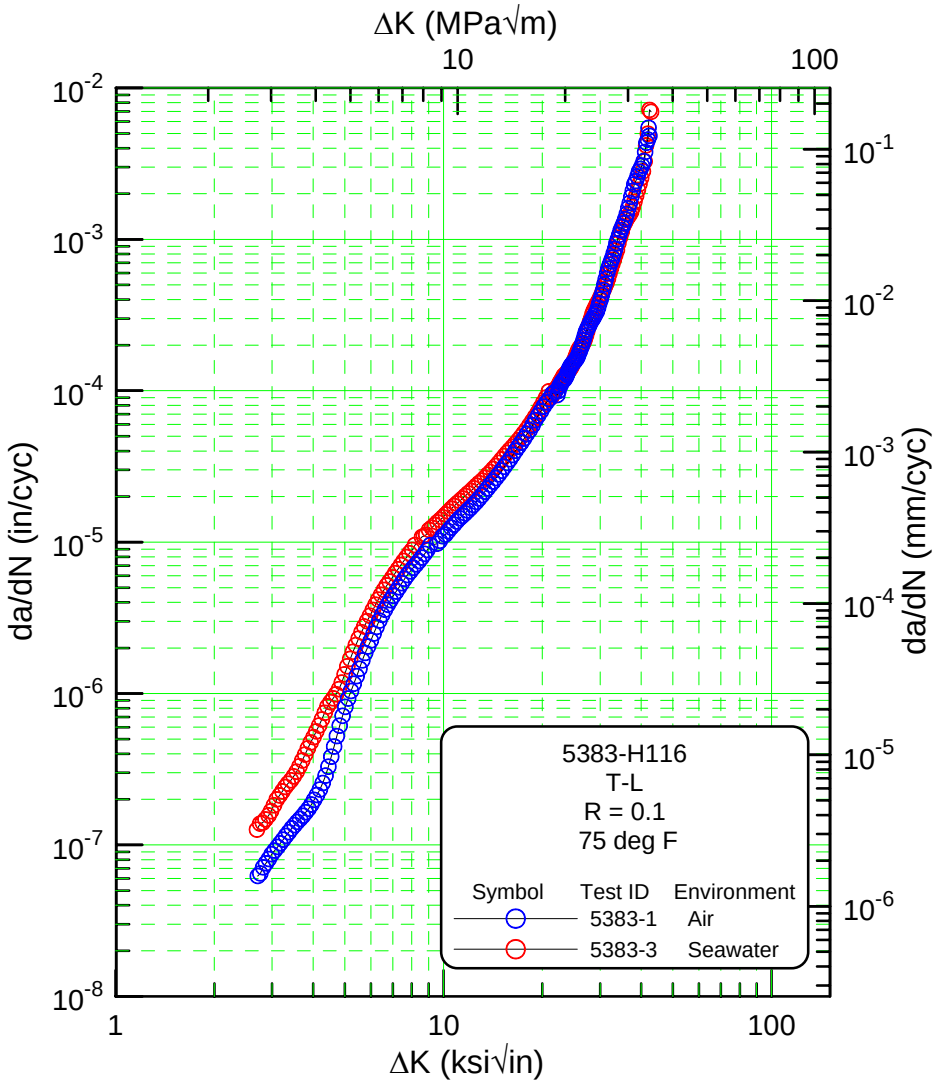

Figure 12. *FCGR response showing the effect of environment for the 5383-H116 alloy.*

2.5.3 Effect of Material

Figures 13 and 14 show the effect of the grade of material in laboratory air and seawater, respectively. The difference in laboratory air is negligible (Figure 13). Figure 14 shows slightly superior performance with the 5086-H116 alloy.

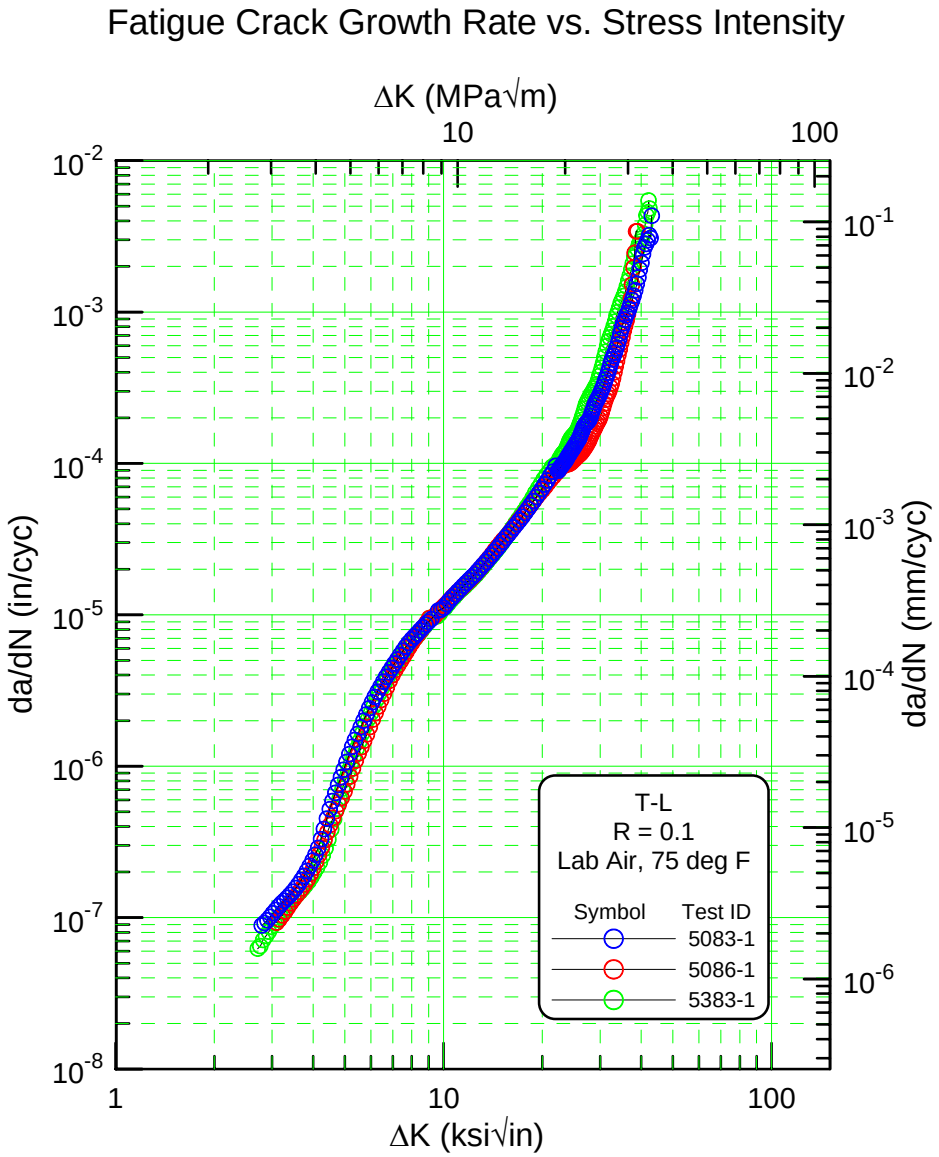

Figure 13. *FCGR response showing the effect of the grade of material in laboratory air.*

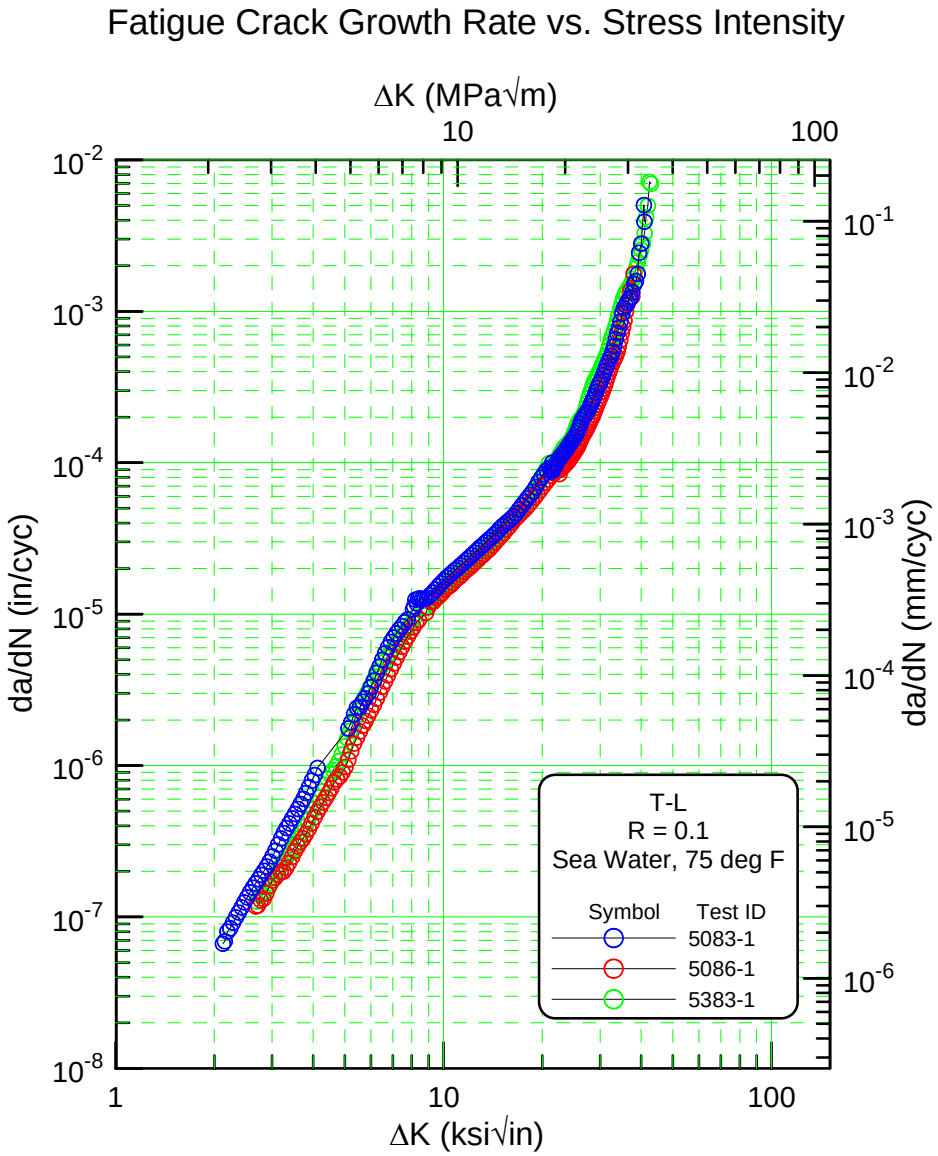

Figure 14. *FCGR response showing the effect of the grade of material in seawater.*

2.5.4 Effect of Frequency

In order to assess the effect of frequency on the FCGR tests conducted in seawater, one sample of each grade of material was tested at three different frequencies (5.0 Hz, 0.5Hz and 0.05Hz). At a frequency of 0.05 Hz, both a sinusoidal waveform shape and a hold at maximum load were investigated. For the dwell segment, the waveform consisted of an unload in 1 second, a reload in 1 second followed by a hold at maximum load for 18 seconds. Figures 15 through 17 show the effect of the frequency for each grade of material in seawater. The effect of frequency was investigated at crack growth rates of ~1-2 x 10^{-6}, ~1-2 x 10^{-5}, and ~1-2 x 10^{-4} inch/cycle. Almost no frequency effect was observed despite a change of two orders of magnitude in frequency. In fact, at growth rates of ~1-2 x 10^{-5} the crack growth rates at 0.05 Hz appeared to be slower, not faster, as would be expected. This behavior suggests that these alloys are fairly resistant to corrosion fatigue in seawater.

2.5.5 Threshold Behavior

Figure 18 shows a comparison of the threshold data for each grade of material. Good agreement was noted where the decreasing and increasing K data overlap. The increasing K data are in good agreement with the previous test data in laboratory air. However, the decreasing K threshold data appear higher than would have been expected from the results of the standard increasing K tests. An examination of the threshold fatigue surfaces indicates darker appearance, most likely associated with crack closure contact. The size of the sample and the long crack length are not generally recommended for threshold testing and this may in part explain some of the deviation in behavior just above the knee of the curve. This difference is clearly illustrated in Figures 19 through 21.

2.5.6 Effect of Crack Closure

In order to properly interpret the results of standard fatigue crack growth tests, it is often necessary to incorporate corrective techniques to the ΔK applied data. Since Elber discovered the existence of crack closure, it has become a widely used tool to explain the extrinsic response of fatigue crack growth rate behavior. Crack closure is a crack tip shielding mechanism whereby the crack-tip cyclic strain is partially shielded from damaging stress. The source of this shielding is most commonly caused by crack wake interference due to plasticity, roughness (microstructure), oxide and/or residual stress. The experimental measurement of crack closure has been hampered by widely varying and non-repeatable methods of evaluation.

Furthermore, experimental observations are subject to varying and inconsistent methods of interpretation. In an attempt to improve consistency of measurement, ASTM E647 has an automated offset opening load technique. After two round-robin programs, this method was adopted as an annex to the ASTM E647 standard. However, this method often over corrects the ΔK applied data primarily because the method fails to account for evidence of crack tip cyclic strain below the opening load. This is especially important if the closure mechanism is not necessarily near the crack tip but distributed along the full wake of the crack.

As an alternative approach, the adjusted compliance ratio (ACR) method of determining the effective stress intensity has been useful in accounting for compressive residual stress and other sources of remote closure resulting in an intrinsic FCGR curve that is thought to emulate the small crack behavior. The method uses the same load-displacement records as the opening load method, but it accounts for partial closure effects (effects below the opening load). Further details of this methodology are provided in Annex B.

The data from Figures 10 through 12 have been re-plotted in Figures 22 through 24 using the ACR method to estimate ΔK_{eff}. These plots show that in the absence of remote closure, the seawater environment has an equivalent or possibly even greater impact of the FCGR behavior. Depending on exposure times, crack size and crack growth rates, the extrinsic behavior (based on $\Delta K_{applied}$) may be different than the intrinsic behavior based on $\Delta K_{effective}$. This is because the environment can work in two ways. It tends to accelerate crack growth due to environmental influence at the crack tip. At the same time it can lead to suppressed crack growth rates due to corrosion product build-up resulting in crack closure shielding in the crack wake. By analyzing the effective stress intensity, the two opposing mechanisms can be partitioned.

A re-examination of the data from Figure 13 shows that when crack closure is accounted for, there is even less difference in the three grades of material (Figure 25). Similarly, in seawater, (Figure 14) some of the perceived differences in lower region II data may be attributed to crack closure as well (Figure 26). Finally, a re-examination of the near-threshold data from Figure 18 also shows that the intrinsic behavior of all three alloys is nearly identical (Figure 27).

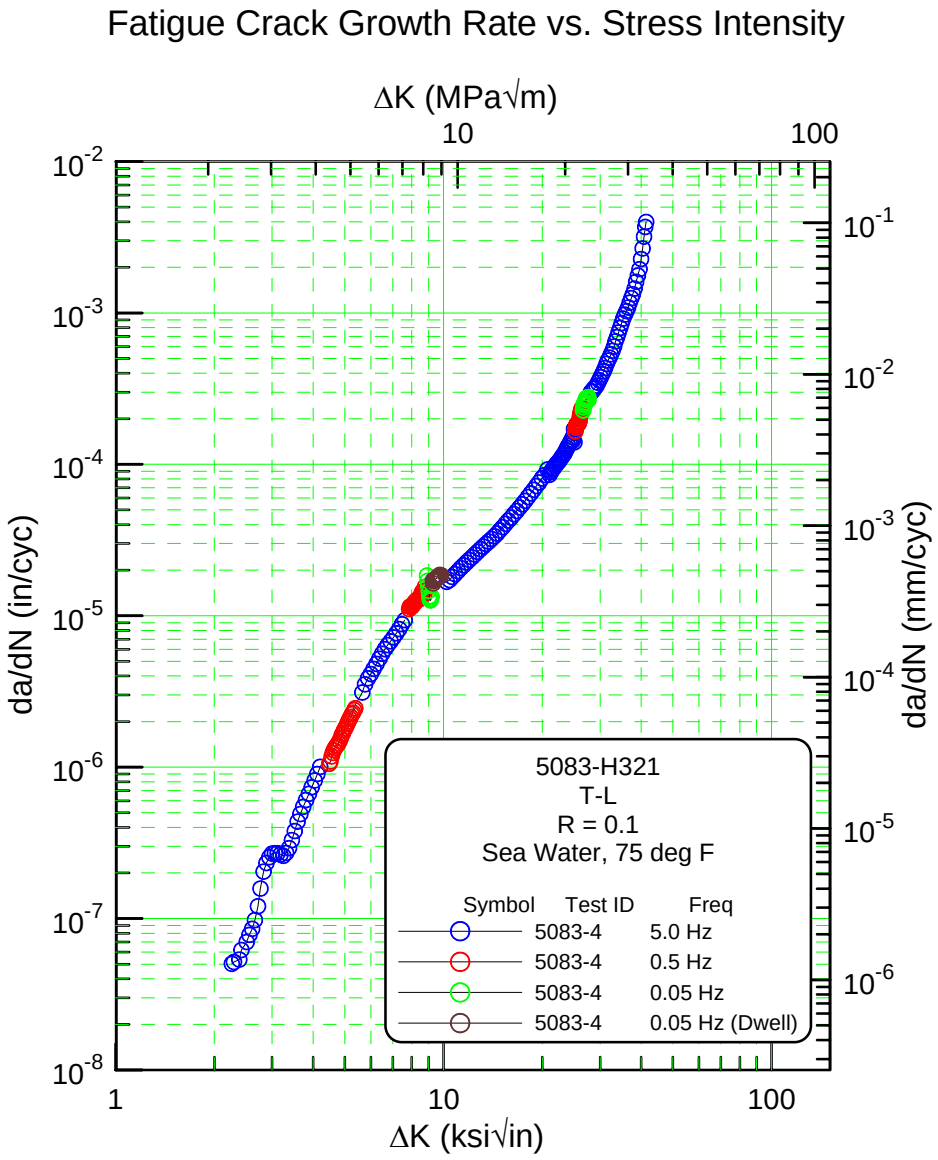

Figure 15. *FCGR response showing the effect of frequency for the 5083-H321 alloy in seawater.*

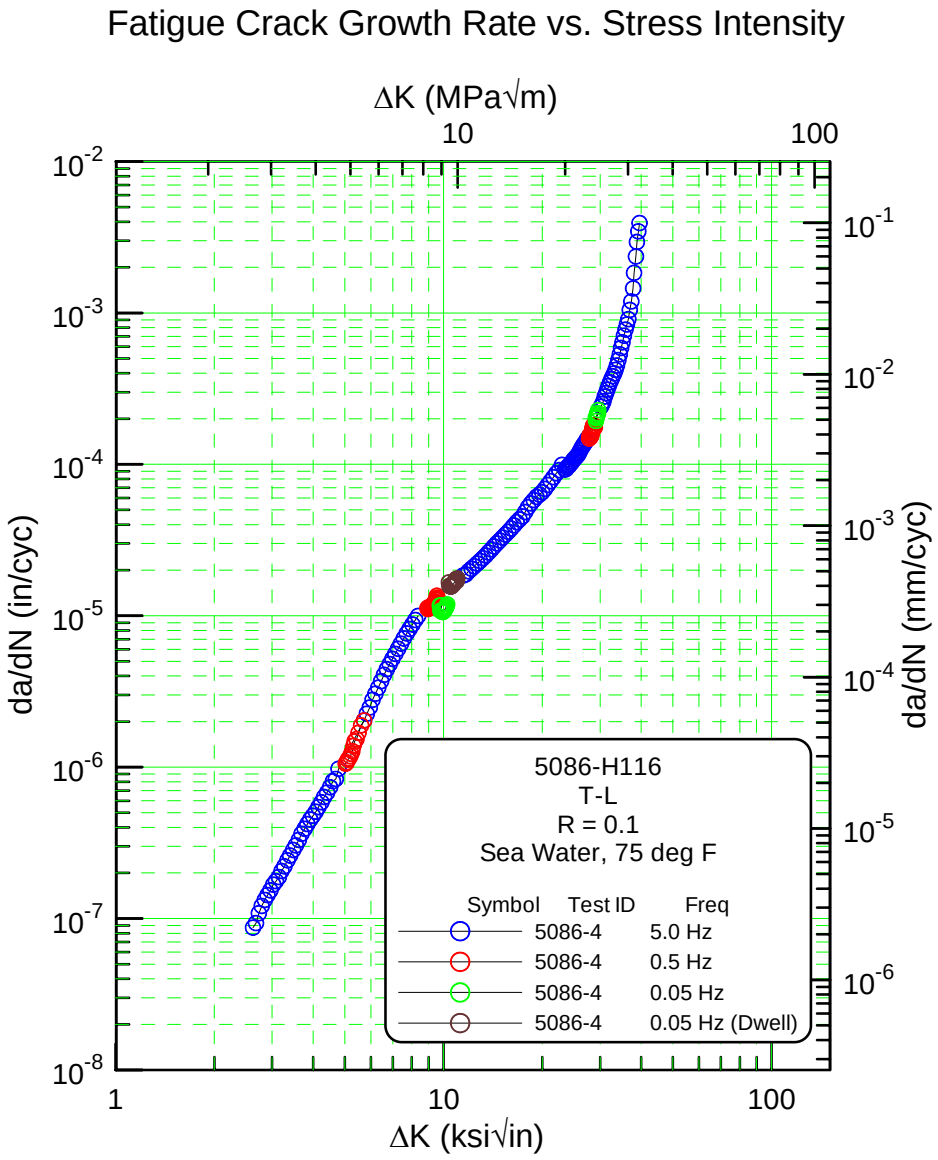

Figure 16. *FCGR response showing the effect of frequency for the 5086-H116 alloy in seawater.*

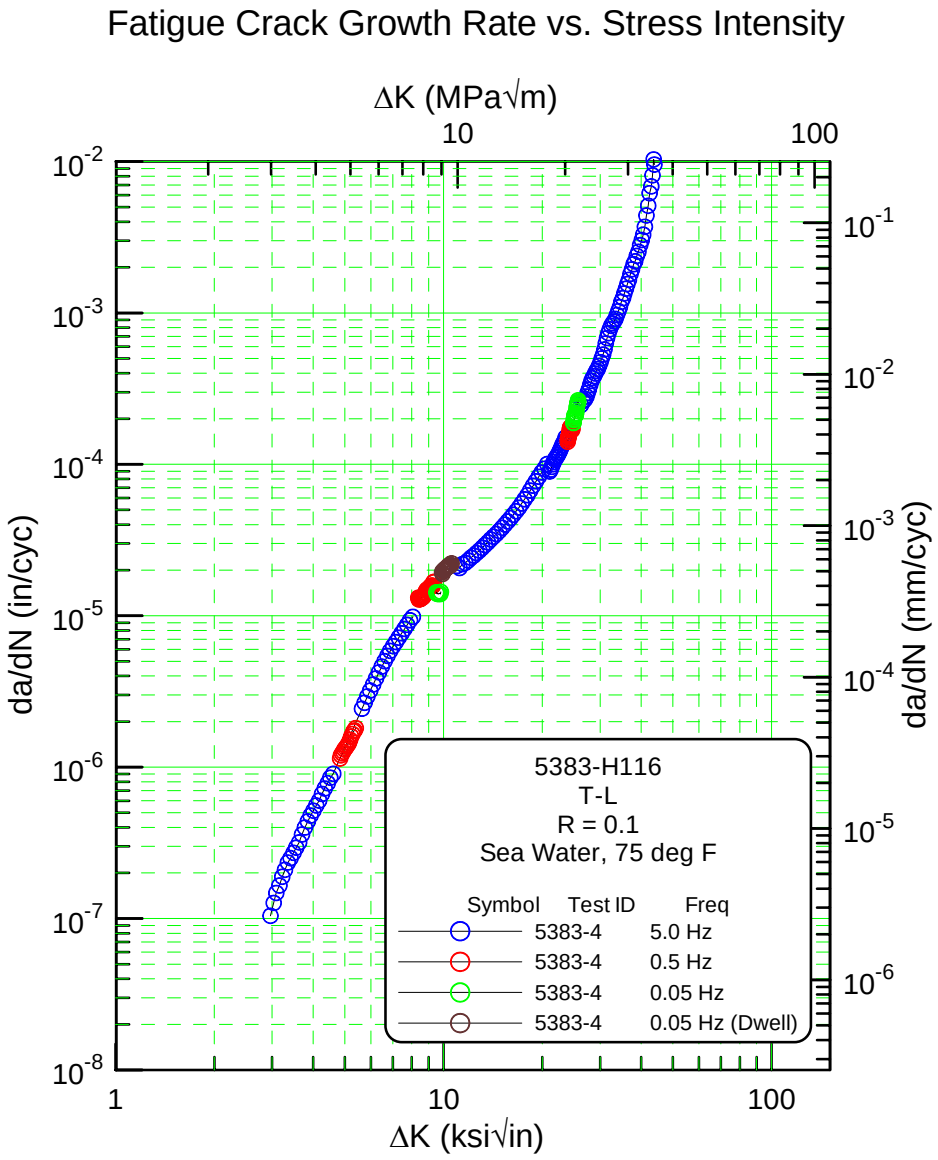

Figure 17. *FCGR response showing the effect of frequency for the 5383-H116 alloy in seawater.*

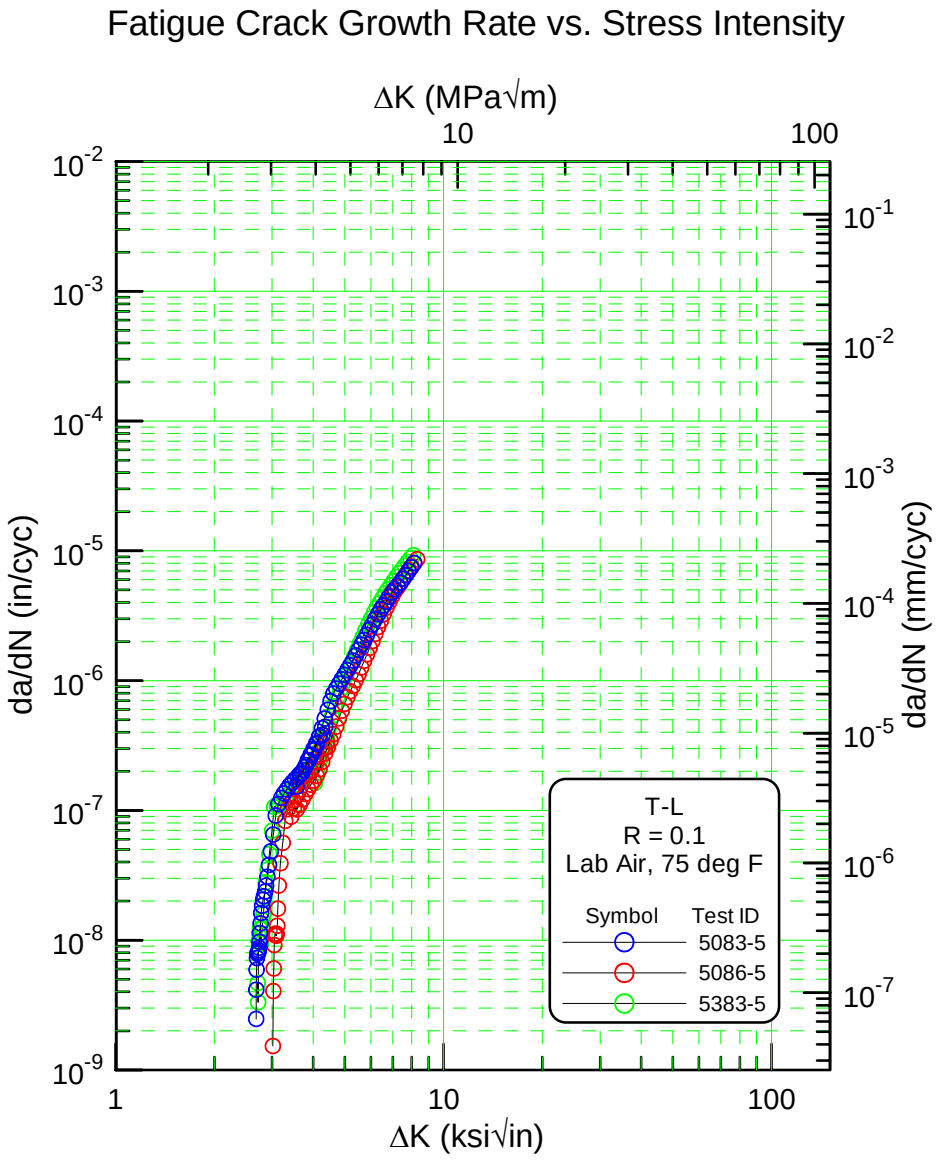

Figure 18. *FCGR response showing the effect of the alloy on near-threshold behavior.*

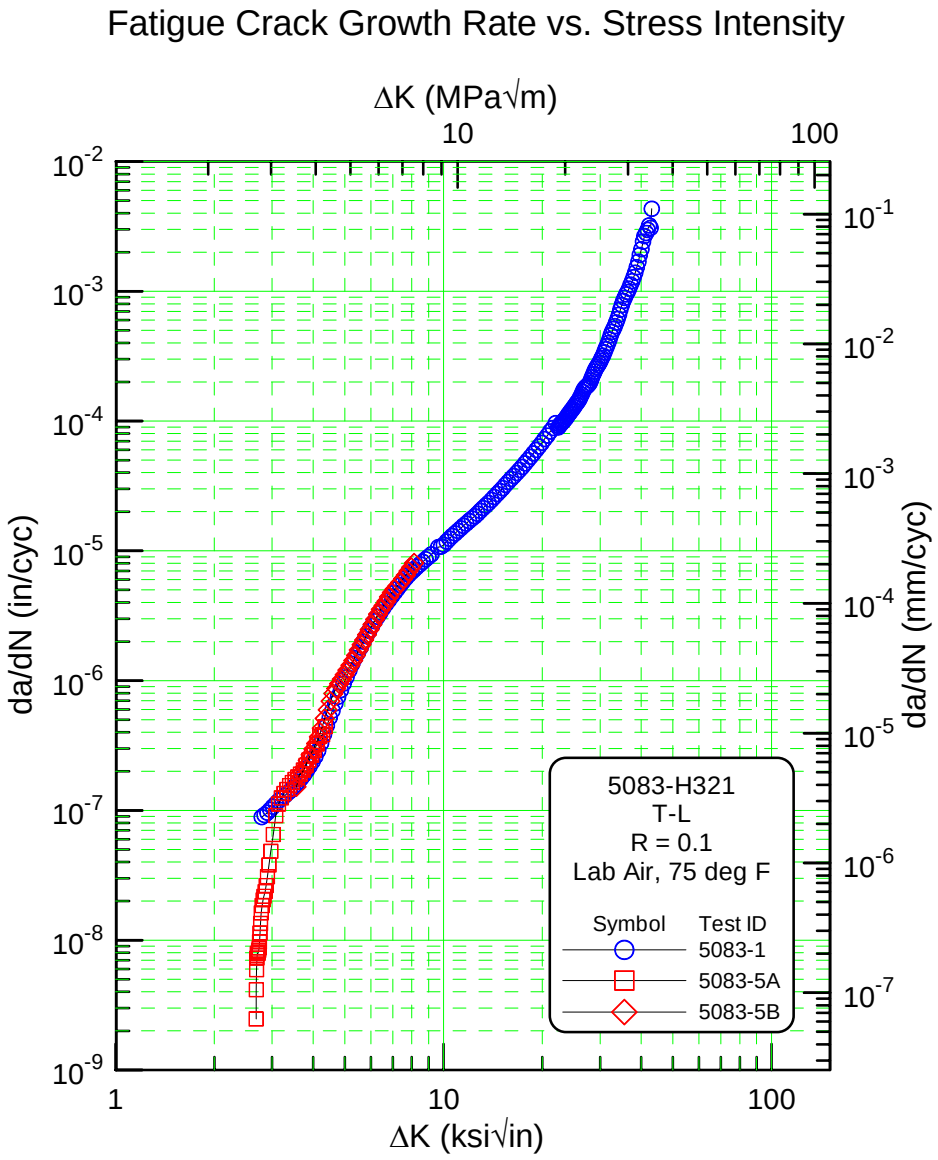

Figure 19. *FCGR response comparing near-threshold behavior with previous increasing K data for the 5083-H321 alloy. Note departure in behavior at ~1 x 10^{-7} inch/cycle.*

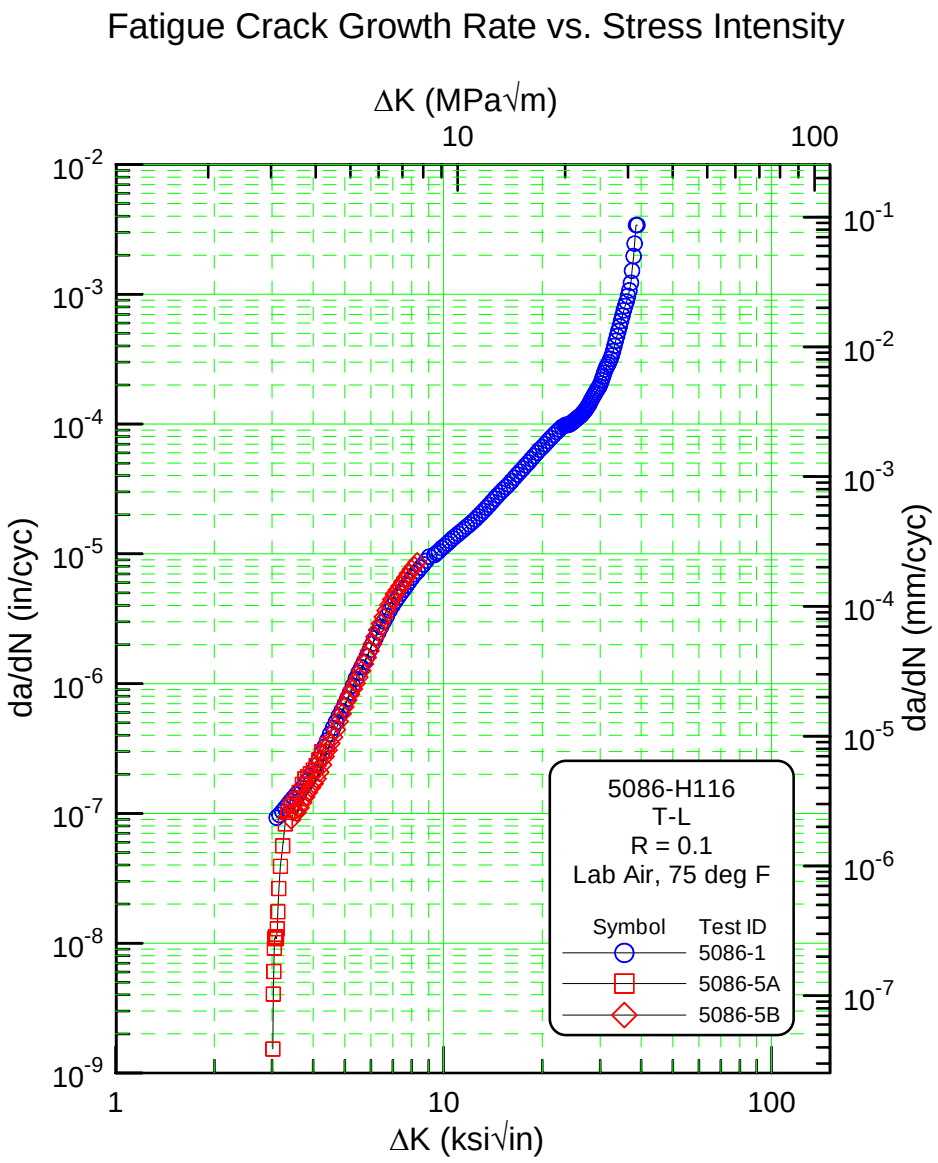

Figure 20. *FCGR response comparing near-threshold behavior with previous increasing K data for the 5086-H116 alloy. Note departure in behavior at ~1 x 10^{-7} inch/cycle.*

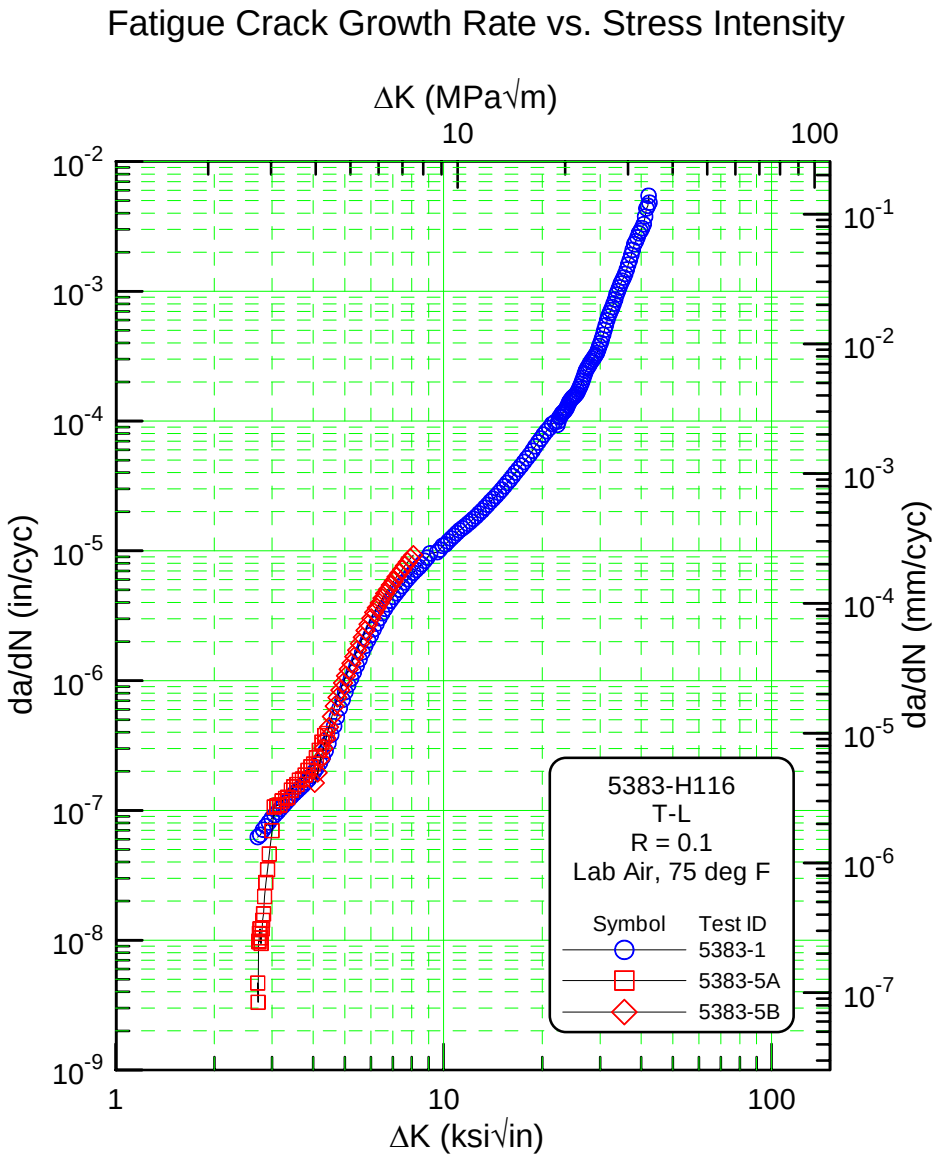

Figure 21. *FCGR response comparing near-threshold behavior with previous increasing K data for the 5383-H116 alloy. Note departure in behavior at ~1 x 10^{-7} inch/cycle.*

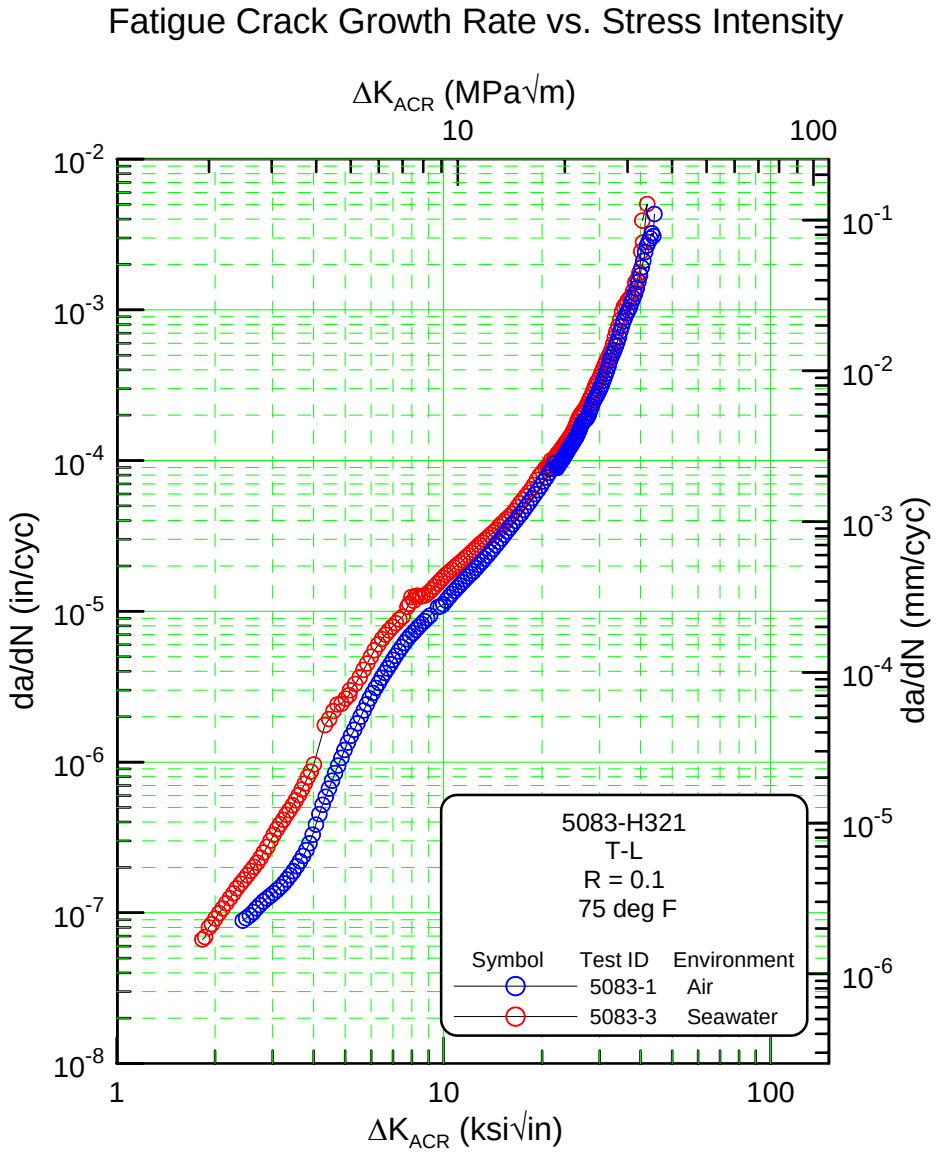

Figure 22. *FCGR response showing the effect of environment for the 5083-H321 alloy. Data are corrected for closure using the ACR method.*

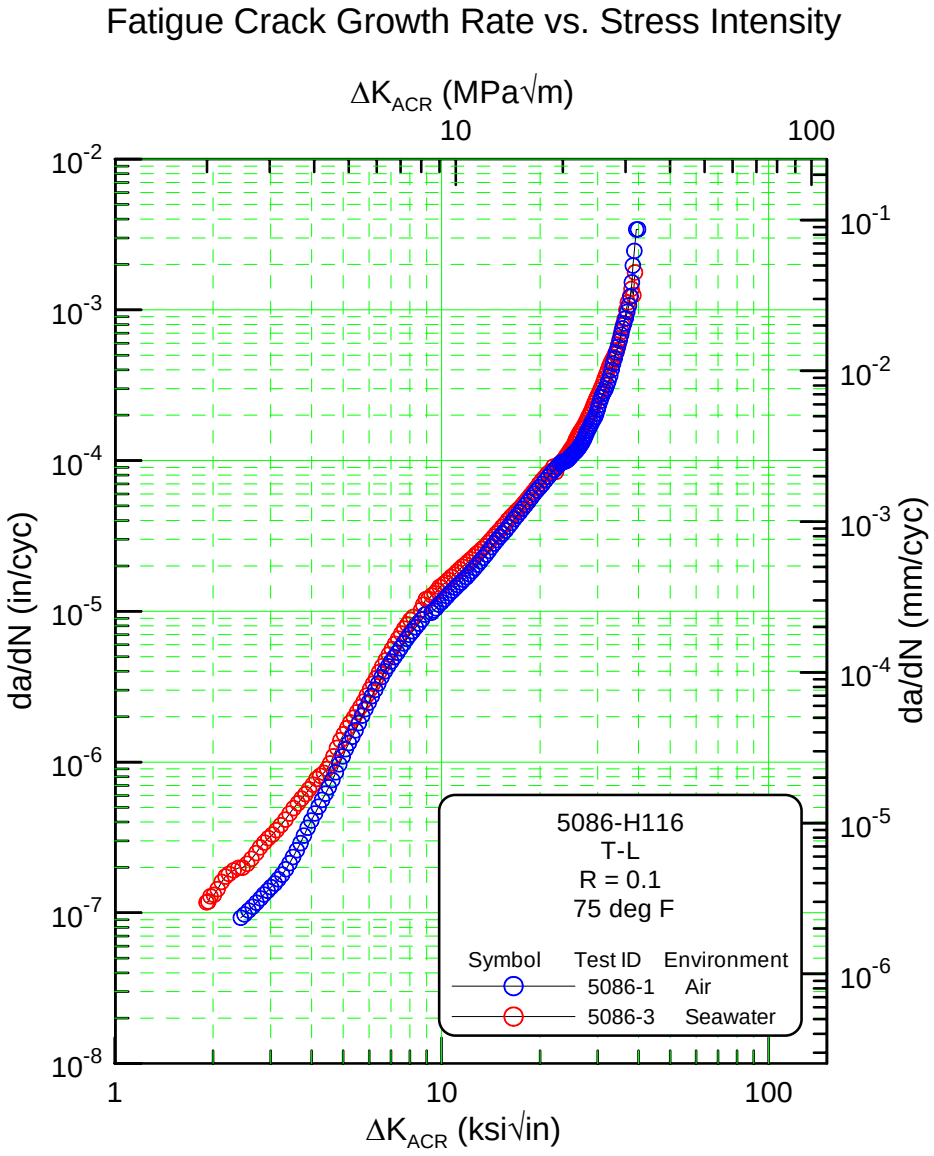

Figure 23. *FCGR response showing the effect of environment for the 5086-H116 alloy. Data are corrected for closure using the ACR method.*

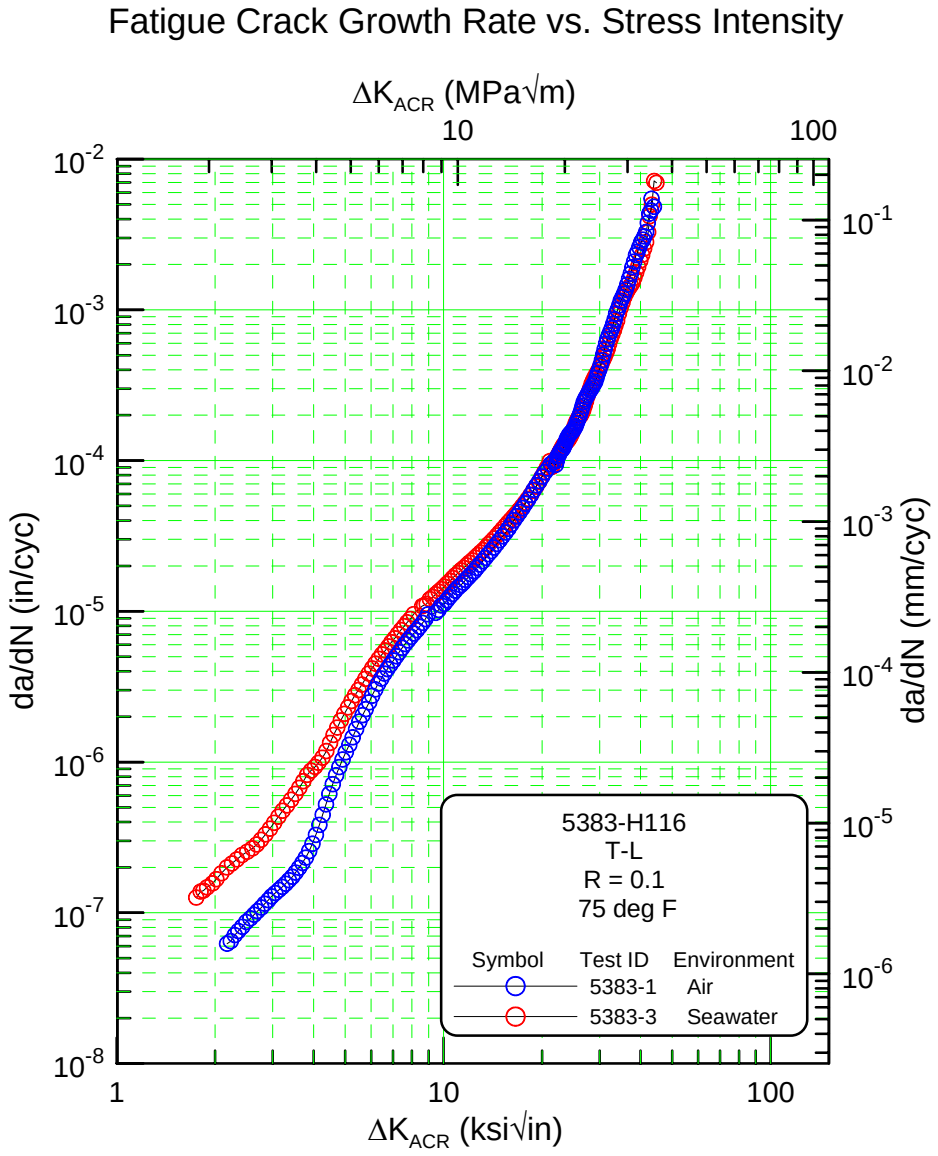

Figure 24. *FCGR response showing the effect of environment for the 5383-H116 alloy. Data are corrected for closure using the ACR method.*

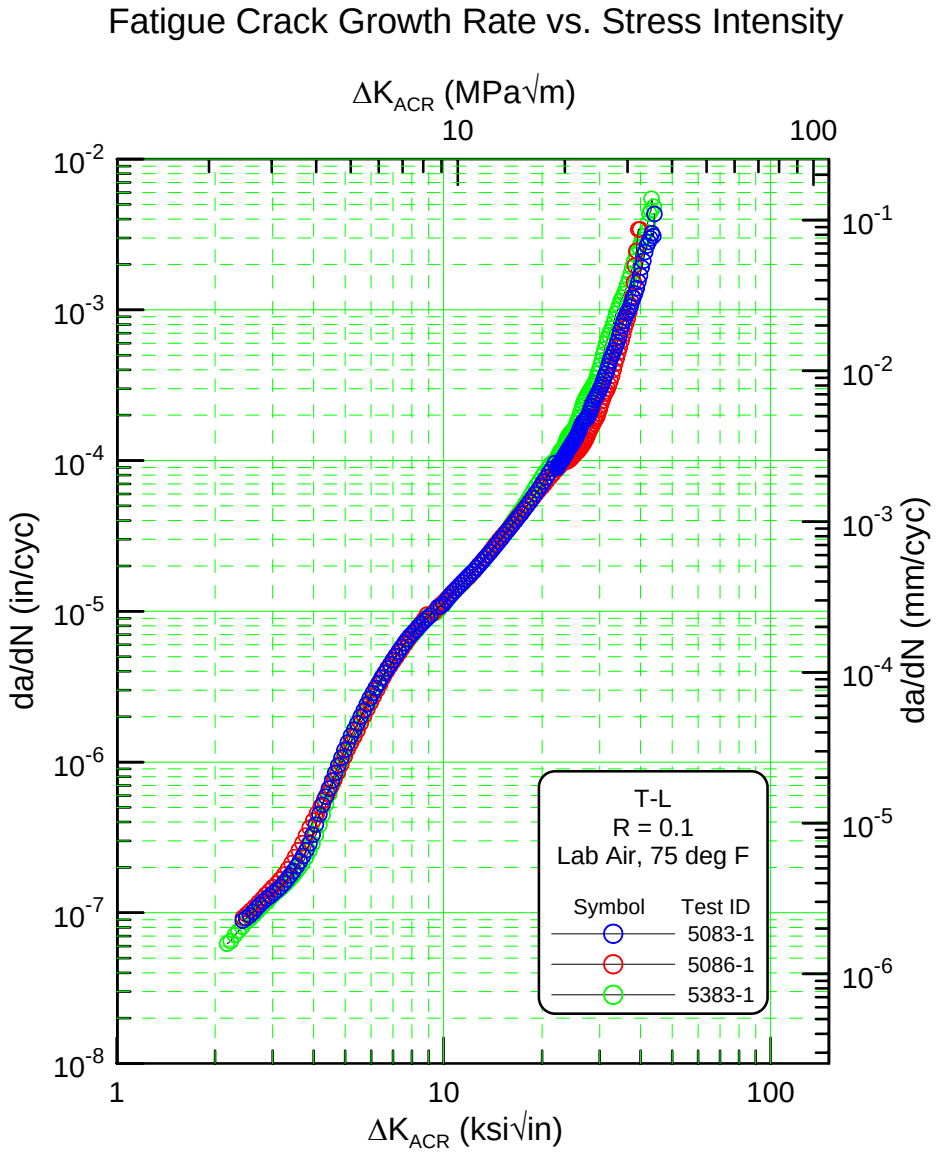

Figure 25. *FCGR response showing the effect of the grade of material in laboratory air. Data are corrected for closure using the ACR method.*

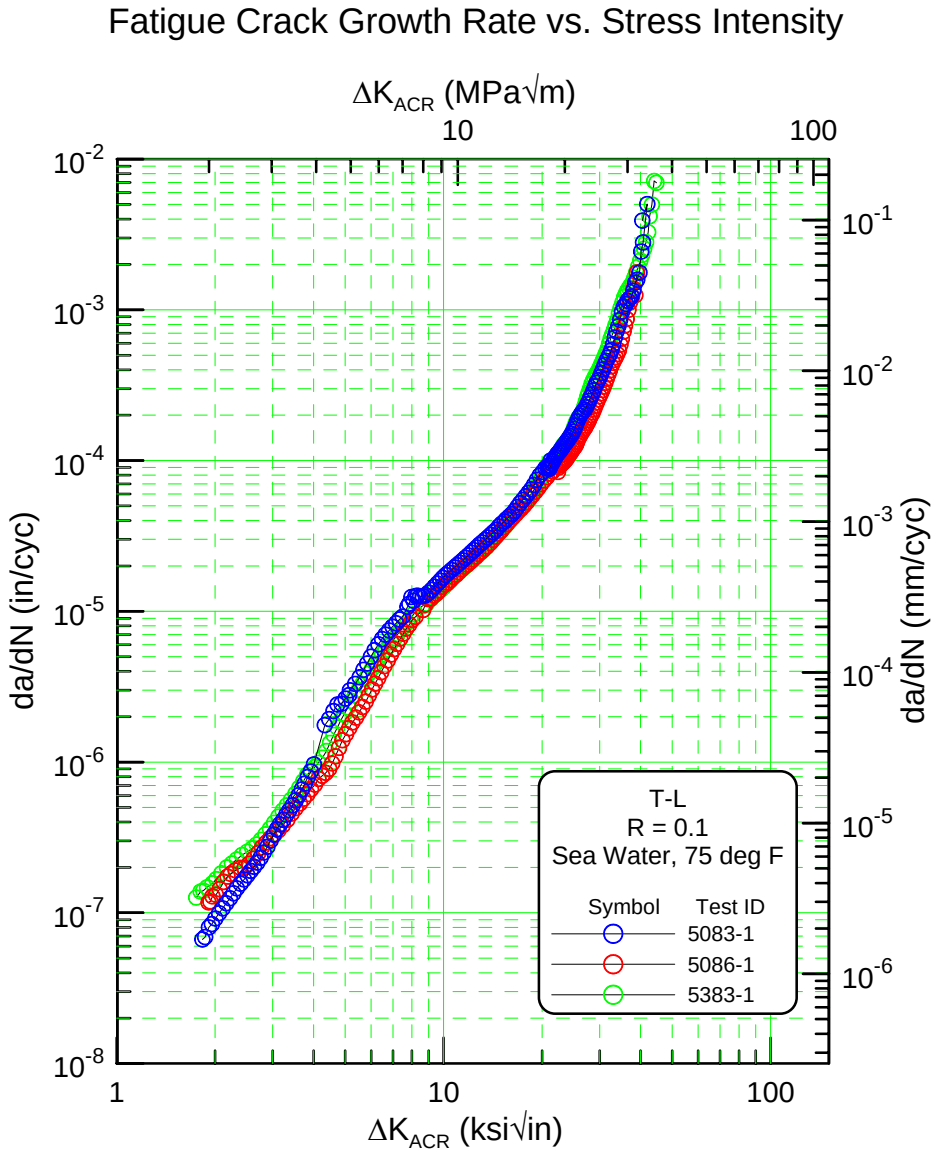

Figure 26. *FCGR response showing the effect of the grade of material in seawater. Data are corrected for closure using the ACR method.*

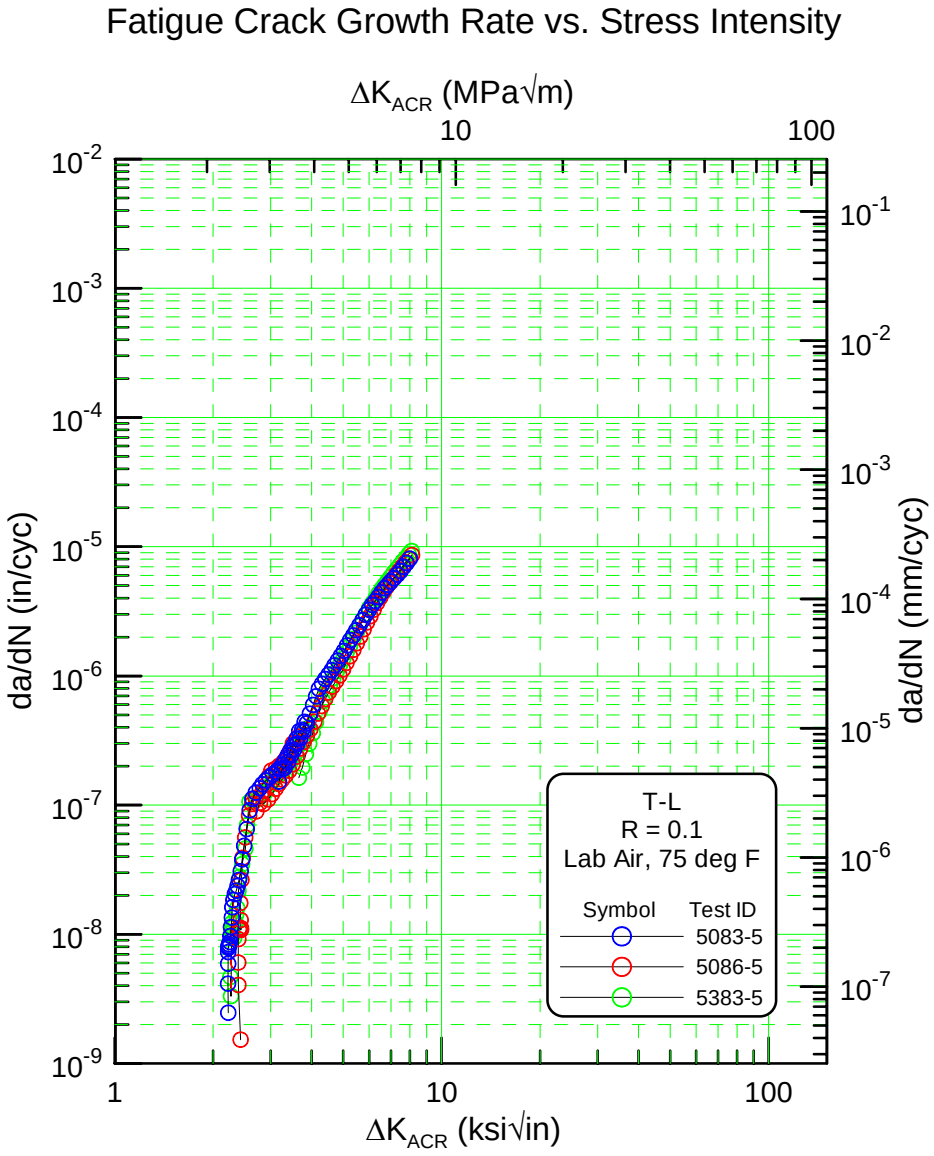

Figure 27. *FCGR response showing the effect of the alloy on near-threshold behavior. Data are corrected for closure using the ACR method.*

3. Non-Linear Fracture Toughness Characterization

3.1 Introduction

Non-Linear fracture toughness testing (NLFT) testing was conducted on three grades of aluminum alloys designated 5083-H321, 5086-H116 and 5383-H116. A compact tension sample having a width of 2.000 inches and a thickness of 0.500 inches was chosen for the majority of the NLFT testing. In addition, a compact tension sample having a width of 4.000 inches and a thickness of 0.500 inches was used to evaluate size effects. For each grade of material, two replicate tests were conducted using full thickness samples without side grooves. A third set of samples was tested with side-grooves to evaluate constraint effects. All samples were machined in the T-L orientation and all samples were tested laboratory air. Testing was performed in accordance with the ASTM E 1820-01 "Standard Test Method for Measurement of Fracture Toughness. A single specimen unloading compliance technique was used to monitor stable crack extension.

3.2 Test Equipment

The tests were conducted on one MTS load frame equipped with a 5,000 lbf load cell and interfaced to an Adwin-Gold FTA computer system and configured for fracture toughness testing. An MTS model 632.03B-30 (opt 006) clip gage was used for load-line displacement measurement. Compliance measurement accuracy was enhanced by mounting needle bearings in both the clevis holes and the specimen holes to minimize non-linearity in the load-displacement signal due to pin friction. Laboratory temperature and relative humidity were controlled to 75°F ±2°F and 40% ±5% R.H. throughout the entire period of testing.

3.3 Sample Preparation

The test samples were machined according to Figure 28.

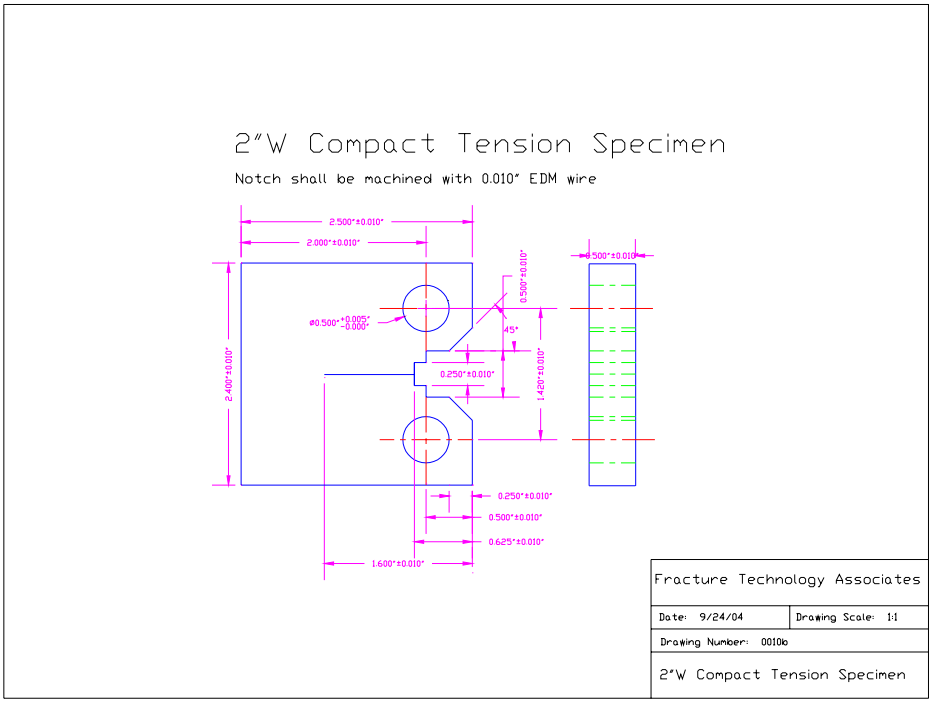

Figure 28. *Diagram of C(T) sample for fracture toughness testing (diagram reproduction not to scale).*

3.4 Test Procedure

Data storage (.raw file extension) was set to 2 points per second for load displacement data in the ramp up/ramp down mode; 0.2 points per second for load displacement data during the hold mode, and 10 points per second for unloading slope data (.unl file extension). The actuator loading and unloading rate was set to 0.020 inches/minute. Each test was initially ramped to the approximate pre-crack load and several unloading slopes were performed with a loading/unloading data acquisition rate of 10 points/second to ensure the specimens were properly seated. The correlation coefficient of each unloading slope was typically 0.99998. After verification that the unloading slopes were repeatable and that the compliance measured crack length was within 2% of the predicted crack length, actual testing commenced. Load and clip gage displacement were recorded in the analysis file every 0.0010 - 0.0020 inches of clip gage displacement or every 200 lbs. increase in load. In addition, the largest observed load and corresponding displacement were stored.

Each test was terminated after about 0.2 inches of stable crack extension. The sample was then fatigue loaded to mark the final crack extension. A nine point average of the pre-crack as well as the final stable crack extension was recorded and used to verify the compliance calculated crack extension.

3.5 Test Results and Discussion

Table 5 summarizes key test conditions and results. The fracture toughness results are based on the J at initiation (J_{Ic}) according to ASTM E1820-01 as well as an equivalent K at initiation designated K_{JIc}. The toughness values at initiation for the side grooved and non-side grooved samples were almost equivalent. The larger sample size gave slightly higher values of toughness at initiation. Regardless of the size of the sample or the absence or presence of the side grooves, all samples showed the same ranking of toughness with the 5086-H116 showing the highest toughness, followed by the 5083-H321, and the 5383-H116 alloy showing the lowest toughness.

Table 5. *Summary of Fracture Toughness Test Conditions and Results (Temperature: 75°F, Orientation: T-L, Environment: Lab Air (RH = 40%)).*

Test ID	Material	Sample Size (W, in)	Side-Groove	J_{Ic}-1820 (in-lb/in^2)	K_{JIC} (ksi √in)	Comments
5083-FT-1	5083-H321	2.00	no	96.6	33.4	Significant crack tunneling
5083-FT-2	5083-H321	2.00	no	91.8	32.6	Significant crack tunneling
5083-FT-3	5083-H321	2.00	yes	111.4	35.9	Straight crack front
5083-FT-5	5083-H321	4.00	no	146.9	41.2	Significant crack tunneling
5086-FT-1	5086-H116	2.00	no	155.4	42.3	Significant crack tunneling
5086-FT-2	5086-H116	2.00	no	147.6	41.3	Significant crack tunneling
5086-FT-3	5086-H116	2.00	yes	155.2	42.3	Straight crack front
5086-FT-5	5086-H116	4.00	no	201.0	48.2	Significant crack tunneling
5383-FT-1	5383-H116	2.00	no	86.6	31.6	Significant crack tunneling
5383-FT-2	5383-H116	2.00	no	86.1	31.5	Significant crack tunneling
5383-FT-3	5383-H116	2.00	yes	90.3	32.3	Straight crack front
5383-FT-5	5383-H116	4.00	no	99.9	34.0	Significant crack tunneling

The most significant difference between the side grooved and non-side grooved samples is illustrated in Figure 29. These R-curves show stable crack extension well beyond maximum load. The samples without the side grooves are representative of the fracture toughness characteristics of the 0.5 inches plate whereas the side grooved samples are representative of much thicker material since the side grooves add additional constraint and suppress plane stress behavior. Data beyond crack initiation

should be used with caution since stable crack extension behavior is highly geometry/application dependent (See annexes for details). The ranking of the alloys is also clearly indicated consistent with the previous observations regarding toughness at initiation. The reproducibility of duplicate tests is also clearly indicated.

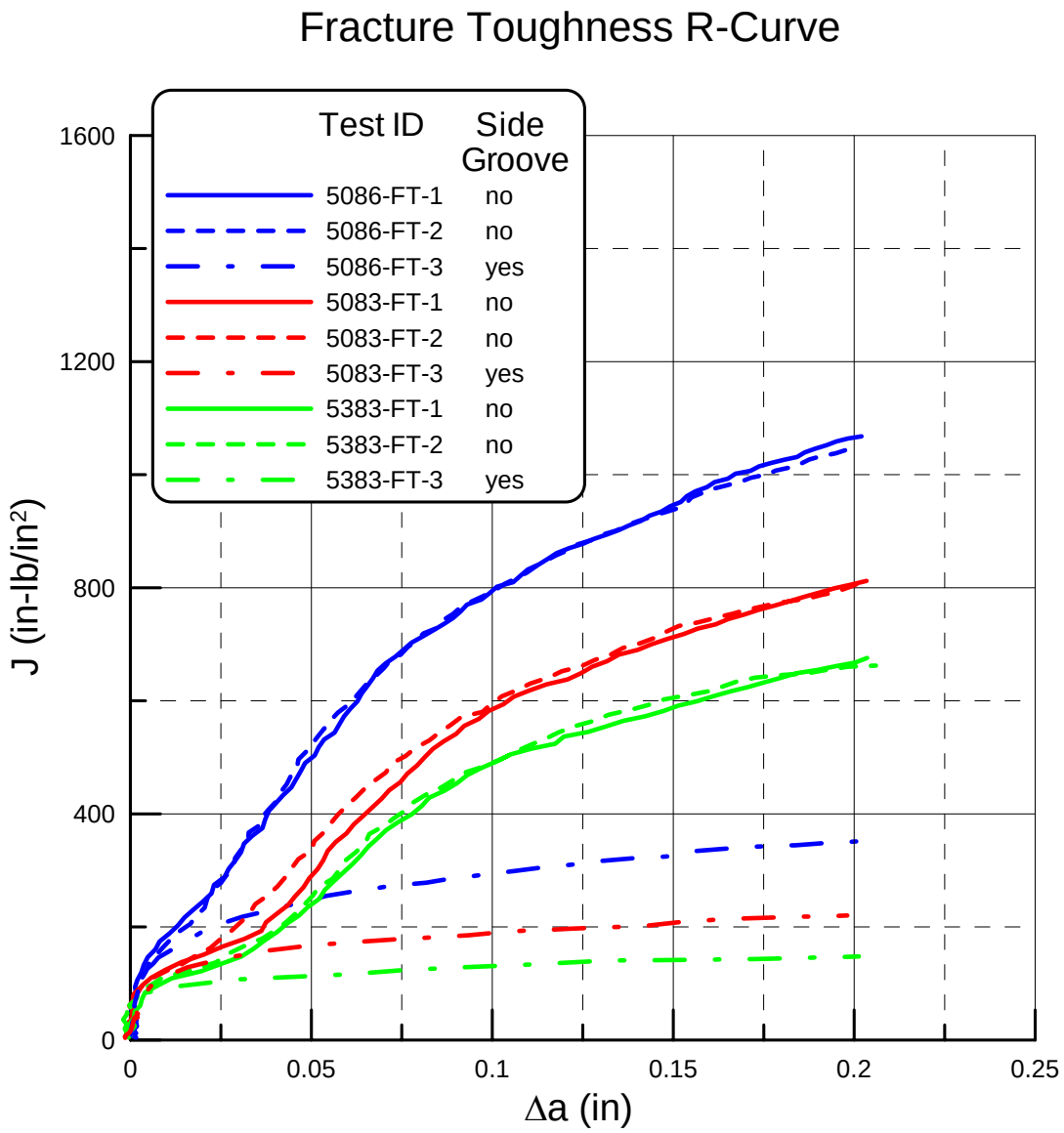

Figure 29. *Non-linear fracture toughness showing ranking of alloys as well as duplicate test results and the effect of side grooves.*

Figure 30 illustrates the effect of sample size. In all cases, the larger sample size shows slightly higher values of toughness at a given increment of crack extension. Figures 31 and 32 show the same trends but the toughness values have been presented as equivalent values of stress intensity K instead of J.

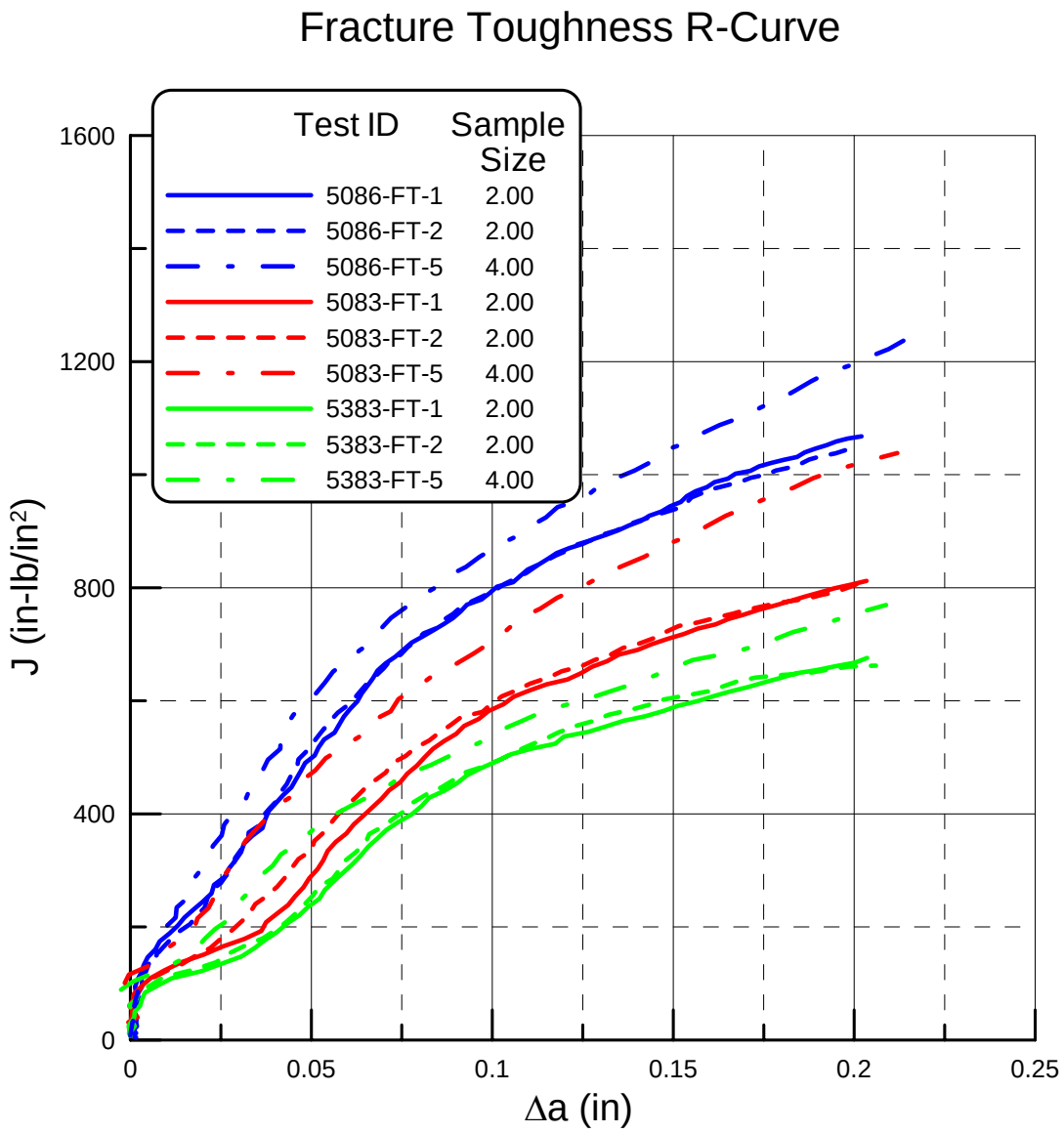

Figure 30. *Non-linear fracture toughness showing ranking of alloys as well as duplicate test results and the effect of sample size.*

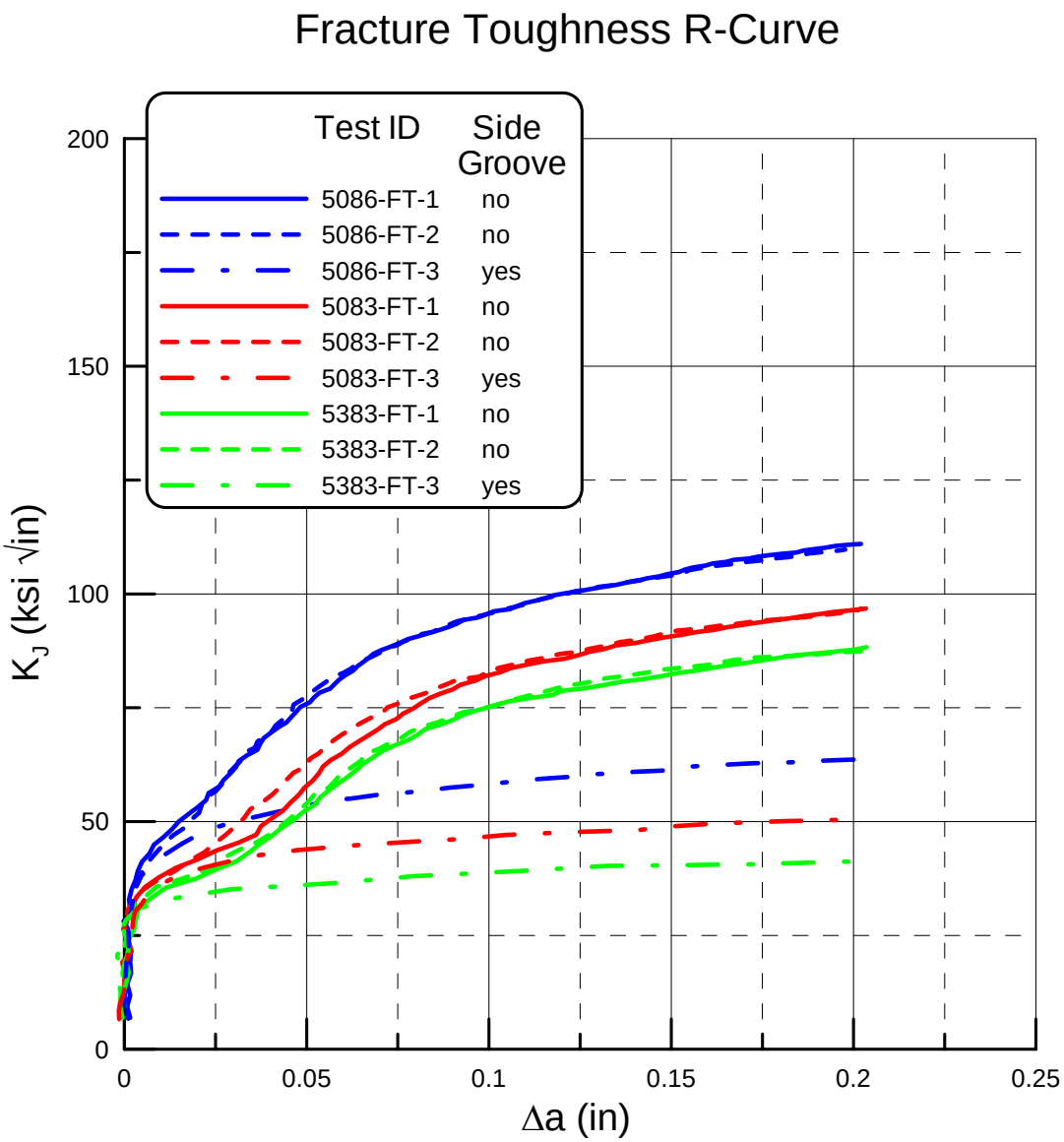

Figure 31. *Non-linear fracture toughness showing ranking of alloys as well as duplicate test results and the effect of side grooves. Equivalent K is plotted.*

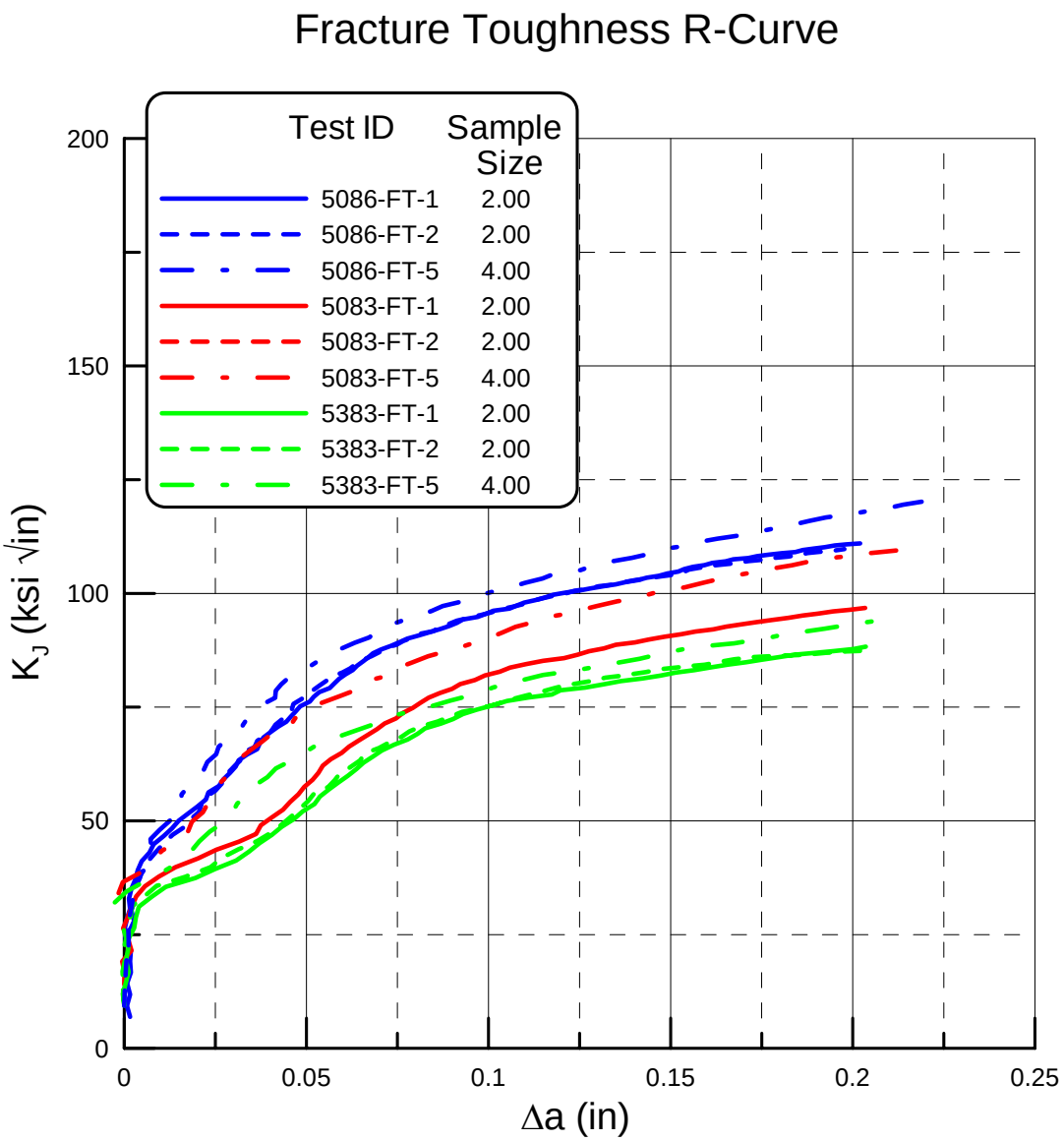

Figure 32. *Non-linear fracture toughness showing ranking of alloys as well as duplicate test results and the effect of sample size. Equivalent K is plotted.*

The photographs in Annex C clearly show the crack straightness characteristic of each test. Annex F contains individual J *vs*. Δa plots. Annex G contains load *vs*. load-line displacement curves. Annex H contains the tabular results of the ASTM 1820 analyses including a summary of validity statements for each test.

Annex A – Procurement and Characterization of Alloys

A1. Summary

The Project Technical Committee selected four alloys – 5083 H321, 5086 H116, 5383 H116, and 5059 H321 – in ½-in-thick plates conforming to ASTM B 928. After much searching, a supplier (warehouse) was found that could supply three of the four selected alloys.

5083 H321 was supplied as 5083 H321 to ASTM B 928 and meets ASTM B 928 for mechanical properties and chemical composition. Metallographic examination showed that this alloy is not sensitized but has considerable grain boundary ***Beta*** and may have more than 15 mg/cm^2 mass loss in ASTM G 67.

5086 H116 was supplied as 5086 H32 to ASTM B 209 and met both ASTM B 928 for mechanical properties and chemical composition except for yield strength (27.0 ksi vis-à-vis 28.0 ksi minimum) and ASTM G 66 for exfoliation susceptibility. Metallographic examination showed that this alloy is not sensitized and has the least grain boundary ***Beta*** of the three alloys examined.

5383 H116 was supplied as 5383/5083 H116 to ASTM B 209 and met both ASTM B 928 for mechanical properties and chemical composition except for Fe and Mn content (respectively, 0.29% vis-à-vis 0.28% maximum and 0.53% vis-à-vis 0.7 - 1.0%) and ASTM G 66 for exfoliation susceptibility. Metallographic examination showed that this alloy has less grain boundary ***Beta*** than the 5083 H321 alloy examined.

It is interesting to note that the alloy furnished to ASTM B 928 – 5083 H321 – showed more ***Beta*** phase on the grain boundaries than either alloy – 5086 H32 and 5383 H116 – furnished to ASTM B 209.

No source could furnish grade 5059 in either temper, H116 or H321.

The mechanical properties and chemistries of the three alloys are compared in, respectively, Tables 6 and 7.

Table 6. *Summary of Mechanical Properties.*

Alloy	0.2% Yield Strength, ksi		Tensile Strength, ksi		Percent Elongation in 1 inch		Percent Reduction of Area	
	Long.	Transv.	Long.	Transv.	Long.	Transv.	Long.	Transv.
5083 H321	37.9	34.3	52.7	51.8	14.4	19.6	21.3	36.1
5086 H32	27.0	27.0	45.8	46.0	15.1	19.4	16.8	34.2
5383 H116	39.2	35.4	54.2	53.3	13.8	17.3	16.3	27.7

Table 7. *Summary of Chemical Composition.*

Alloy	Weight Percent Maximum							
	Si	Fe	Cu	Mn	Mg	Cr	Zn	Ti
5083 H321	0.15	0.31	0.06	0.50	4.8	0.08	0.09	0.03
5086 H32	0.14	0.31	0.07	0.45	3.8	0.19	0.03	0.03
5383 H116	0.13	0.29	0.06	0.53	4.8	0.10	0.08	0.03

A2. Tempers Used in Marine Alloys

The non-heat-treatable 5xxx alloys are solution-strengthened, primarily, by magnesium. The tempers H116 and H321 have been reserved by the Aluminum Association for wrought products in the 5xxx series containing 3% or more Mg. The temper designations are:

H Strain hardened.

H1 Strain hardened without thermal treatment. Second digit indicates degree of strain hardening.

H116 Strain hardened only.

H3 Strain hardened and stabilized by low temperature thermal treatment. Tensile strength reduced slightly but ductility improved.

H32 Stabilized by a low-temperature thermal treatment after strain hardening. The second digit 2 indicates the degree of strain hardening, i.e., quarter-hard.

H321 Stabilized by a low-temperature thermal treatment after strain hardening less than the amount required for a controlled H32 temper. The third digit identifies variation from H32.

A3. Alloys Furnished to the Project

The PTC of the subject project selected four alloys – 5083 H321, 5086 H321, 5383 H321, and 5059 H321 – in ½-in-thick plates conforming to ASTM B 928[1] for fracture mechanics characterization.

Contacts with both domestic and European aluminum manufacturers and builders of aluminum vessels were unsuccessful. However, a supplier (warehouse) was found that could supply three of the four selected alloys, Table 8. Each alloy was furnished as a ½x24x24-in plate.

No source could furnish grade 5059 in either temper, H 116 or H321.

Table 8. *Plates Furnished by Suppliers.*

Alloy Ordered to B 928	**Supplier**					
	Pierce, Warminster, Pa.			**Pierce, New Orleans, La.**		
	Alloy	**ASTM Std.**	**Mfgr.**	**Alloy**	**ASTM Std.**	**Mfgr.**
5083 H321	5083 H321	B 928	Pechiney			
5086 H116	5086 H32	B 209 [2]	Capral			
5383 H116				5383/5083 H116	B 209	Pechiney

A3.1 Laboratories

Dirats Laboratories, Westfield, Massachusetts, performed the tensile tests and chemical analysis on the three furnished alloys.

The ***tension specimens*** were cylindrical with a test-section diameter of 0.25 in and a gage-length of 1 in. Data for each alloy are presented in the following sections. Note that ***Elongation*** is measured over a gage length of 4 times the diameter of the tension test specimen, i.e., 1 in. Three specimens were taken in both the longitudinal and

[1] ASTM B928/B 928M-04a *Standard Specification for High Magnesium Aluminum-Alloy Sheet and Plate for Marine Service and Similar Environments.*
[2] ASTM B 209-02a *Standard Specification for Aluminum-Alloy Sheet and Plate*.

transverse directions (with respect to rolling direction) from each of the three 0.5 in thick alloys.

The results of the tensile tests and chemical analyses are listed below for each of the three alloys.

Dr Catherine Wong, Materials Engineer, NAVSEA, performed metallography on 2x2x0.5-in samples of each of the three acquired alloys. The primary purpose of this investigation was to determine the extent of the ***Beta*** phase (i.e., magnesium-rich precipitate) precipitation on the grain boundaries.

Her findings and metallographs are presented below for each of the three alloys.

A3.2 *Beta* Phase

In the 5xxx series alloys, magnesium can precipitate out of solution and solidify on the grain boundaries. This magnesium-rich precipitate is known as the ***Beta*** phase. Sensitivity of high magnesium aluminum plates to exfoliation and intergranular corrosion increases with the amount of ***Beta*** phase on the grain boundaries.

Solid lines of ***Beta*** phase are sensitive to intergranular corrosion whilst ***Beta*** phase as spheres at intermittent locations on the grain boundaries is resistant to intergranular corrosion.

The form and amount of Beta phase on the grain boundaries depend on

- Thermal-mechanical rolling practices, i.e., the number of passes, reduction in thickness per pass, total reduction, and metal temperature in each pass.
- Product thickness. E.g., The problem that led to the development of ASTM B 928 was confined to relatively thin 5083 H321 sheets and plates, i.e., 3/8-in thick and below.

A3.3 *Alloy 5083 H321*

For 5083 H321, Pierce, Warminster, Pa., supplied 5083 H321 to ASTM B 928 by Pechiney (France).

The alloy supplied met ASTM B 928 for mechanical properties and chemical composition, respectively, Tables 9 and 10.

Table 9. *Mechanical Properties – 5083 H321.*

Source		0.2% Yield Strength, ksi		Tensile Strength, ksi		% Elongation
		min	max	min	max	min
B 928		31.0	43.0	44.0	56.0	12
Pierce		35.2 — 39.6		52.2 — 53.9		14 — 16
Dirats	Long.	37.9		52.7		14.4
	Transv.	34.3		51.8		19.6
* *Dirats Reduction of Area: Long., 21.3%, Transv., 36.1%*						

Table 10. *Chemical Composition – 5083 H321.*

Source	Weight Percent Maximum unless shown as Range							
	Si	Fe	Cu	Mn	Mg	Cr	Zn	Ti
B 928	0.40	0.40	0.10	0.40 - 1.0	4.0 - 4.9	0.05 - 0.25	0.25	0.15
Pierce	0.11	0.29	0.06	0.52	4.8	0.09	0.09	0.03
Dirats	0.15	0.31	0.06	0.50	4.8	0.08	0.09	0.03

A3.3.1 Metallography

This alloy is not sensitized but has considerable grain boundary ***Beta*** and may have more than 15 mg/cm^2 mass loss in ASTM G 67[3]. Metallographs are shown in Figures 33 and 34 for, respectively, longitudinal and transverse sections.

[3] ASTM G 67 *Test Method for Determining the Susceptibility to Intergranular Corrosion of 5xxx Series Aluminum Alloys by Mass Loss after Exposure to Nitric Acid*

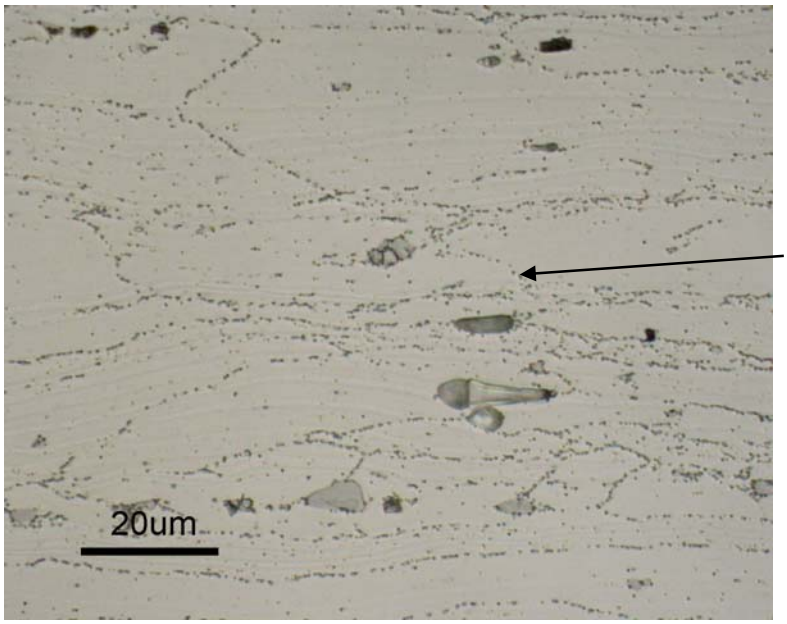

Figure 33. *5083 H321 – Longitudinal.*

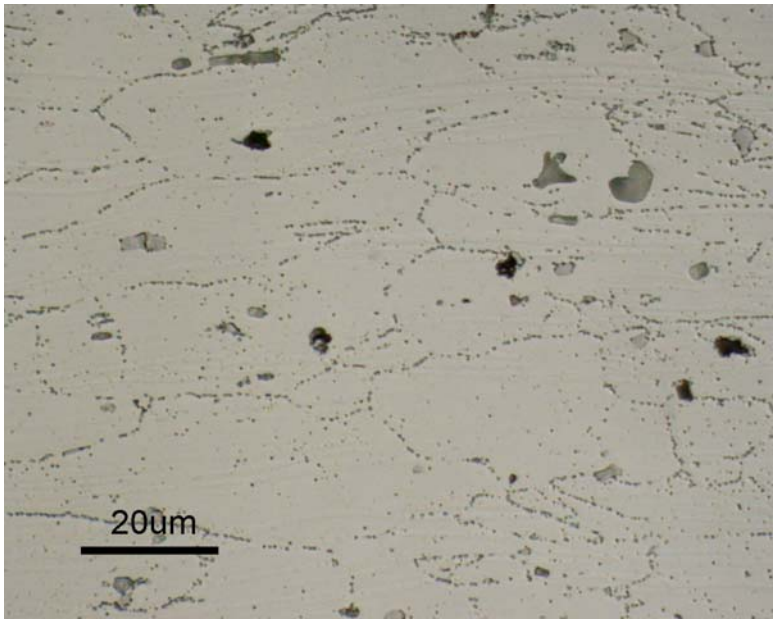

Figure 34. *5083 H321 – Transverse.*

A3.4 *Alloy 5086 H32*

For 5086 H116, Pierce, Warminster, Pa, supplied 5086 H32 to ASTM B 209 manufactured by Capral (Australia).

The alloy supplied met ASTM B 928 for mechanical properties and chemical composition, respectively, Tables 11 and 12, with the exception of yield strength.

The alloy met ASTM G 66[4] for exfoliation susceptibility. ASTM G 67 was not required in ASTM B 209 to which the alloy was supplied.

Table 11. *Mechanical Properties – 5086 H32.*

Source		0.2% Yield Strength, ksi		Tensile Strength, ksi		% Elongation
		min	max	min	max	min
B 928		28.0	—	40.0	—	10
Pierce		34.8		46.3		18
Dirats	Long.	***27.0****		45.8		15.1
	Transv.	27.0		46.0		19.4
Dirats Reduction of Area: Long., 16.8%, Transv., 34.2%						
** Outside specification limits*						

Table 12. *Chemical Composition – 5086 H32.*

Source	Weight Percent Maximum unless shown as Range							
	Si	Fe	Cu	Mn	Mg	Cr	Zn	Ti
B 928	0.40	0.50	0.10	0.20 - 0.7	3.5 - 4.5	0.05—0.25	0.25	0.15
Pierce	0.17	0.27	0.03	0.38	3.8	0.07	0.02	0.01
Dirats	0.14	0.31	0.07	0.45	3.79	0.19	0.03	0.03

A3.4.1 Metallography

This alloy is not sensitized and has the least grain boundary ***Beta*** of the three alloys examined. Metallographs are shown in Figures 35 and 36 for, respectively, longitudinal and transverse sections.

[4] ASTM G 66-95 *Test Method for Visual Assessment of Exfoliation Corrosion Susceptibility of 5xxx Aluminum Alloys.*

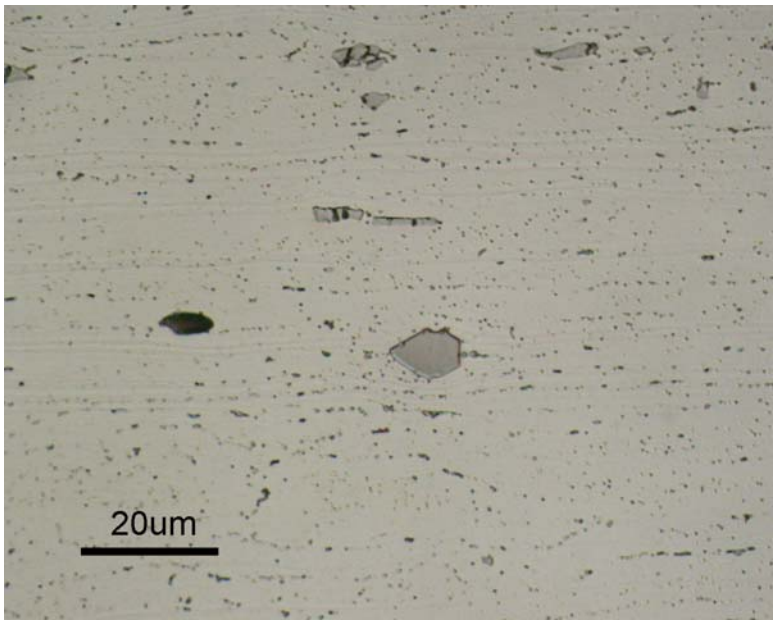

Figure 35. *5086 H32 – Longitudinal.*

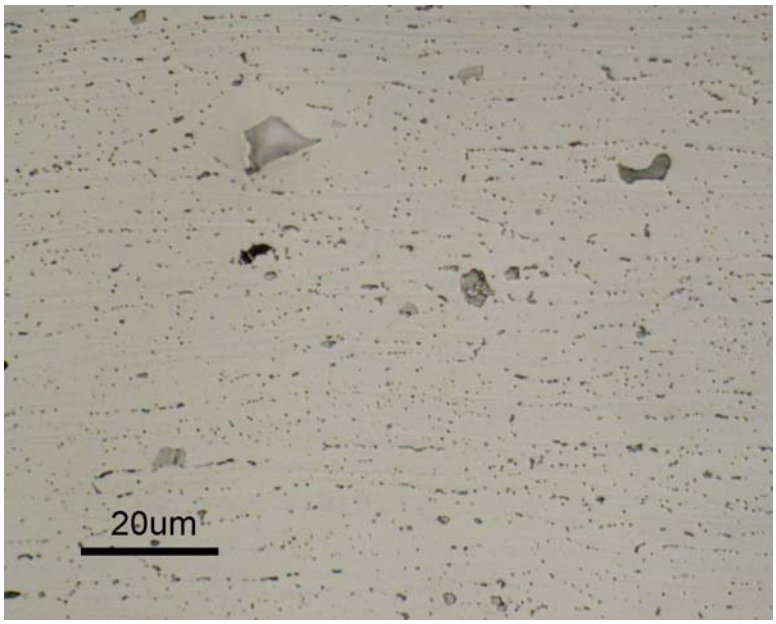

Figure 36. *5086 H32 – Transverse.*

A3.5 *Alloy 5383 H3116*

For 5383 H116, Pierce, New Orleans, La, supplied 5383/5083 H116 to ASTM B 209 manufactured by Pechiney (France).

The alloy supplied met ASTM B 928 for mechanical properties and chemical composition, respectively, Tables 8 and 9.

The alloy met ASTM G 66 for exfoliation susceptibility. ASTM G 67 is not required in ASTM B 209 to which the alloy was supplied.

Table 13. *Mechanical Properties – 5383 H116.*

Source		0.2% Yield Strength, ksi		Tensile Strength, ksi		% Elongation
		min	max	min	max	min
B 928		33.0	—	48.0	—	10
Pierce Certificate		36.3 — 40.7		50.9 —53.4		16 — 17
Dirats	Long.	39.2		54.2		13.8
	Transv.	35.4		53.3		17.3
Dirats Reduction of Area: Long., 16.3%, Transv., 27.7%						

Table 14. *Chemical Composition – 5383 H116.*

Source	Weight Percent Maximum unless shown as Range							
	Si	Fe	Cu	Mn	Mg	Cr	Zn	Ti
B 928	0.25	0.25	0.20	0.7 - 1.0	4.0 - 5.2	0.25	0.40	0.15
Pierce	0.10	***0.28****	0.06	***0.56****	4.73	0.11	0.08	0.03
Dirats	0.13	***0.29****	0.06	***0.53****	4.76	0.10	0.08	0.03
Zr: ASTM B 928, 0.20% max., Pierce, 29 ppm, Dirats, 0.01%								
** Outside specification limits*								

A3.5.1 Metallography

This alloy is not sensitized and has less grain boundary Beta than the 5083 H321 alloy examined. Metallographs are shown in Figure 37 and 38 for, respectively, longitudinal and transverse sections.

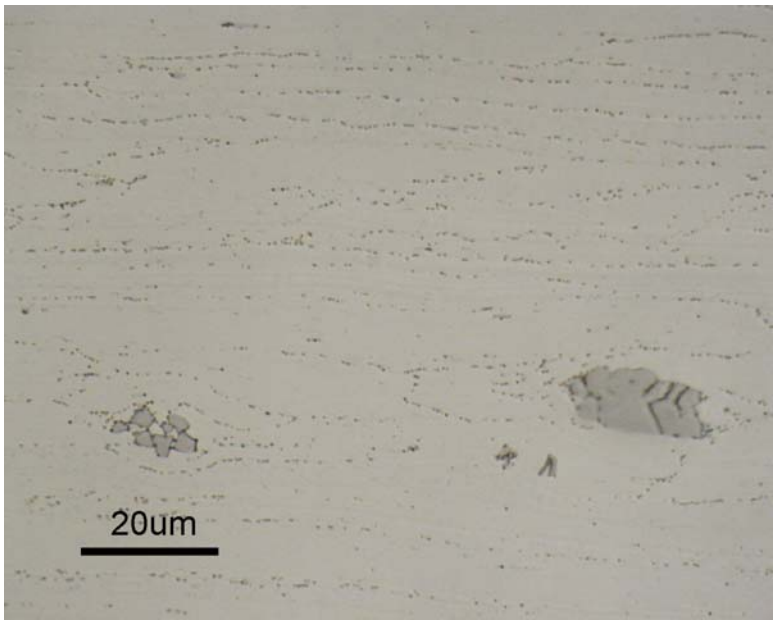

Figure 37. *5383 H116 – Longitudinal.*

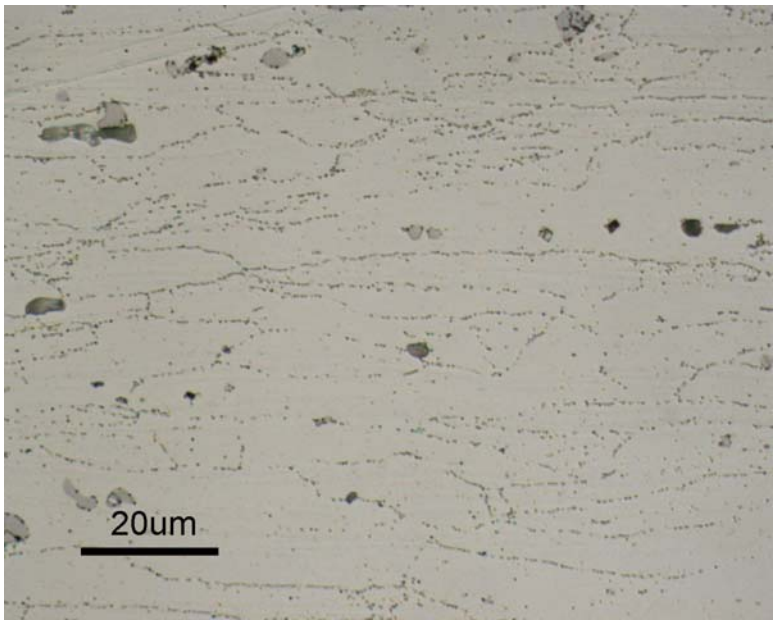

Figure 38. *5383 H116 – Transverse.*

A3.6 *Stress-Strain Curves*

Dirats Laboratories, Westfield, Massachusetts, performed additional tensile tests on the three alloys to determine the engineering and true stress-strain curves.

The ***tension specimens*** were cylindrical with a test-section diameter of 0.25 in and a gage-length of 1 in and were taken in the transverse direction (with respect to rolling direction) from each of the three 0.5 in thick alloys. The engineering and true stress-strain properties are listed in, respectively, Tables 15 and 16.

Table 15. *Transverse Engineering Mechanical Properties.*

Alloy	**0.2% Yield Strength, ksi**	**Tensile Strength, ksi**	**Percent Elongation in 1 inch**	**Percent Reduction of Area**
	Transv.	**Transv.**	**Transv.**	**Transv.**
5083 H321	34.4	51.9	19.4	37.9
5086 H32	27.0	46.1	24.0	34.7
5383 H116	35.0	53.3	22.6	28.1

Table 16. *Transverse True Mechanical Properties.*

Alloy	**0.2% Yield Strain, ε_{YS}, in/in**	**Young's Modulus, E, ksi**	**Strain-hardening Exponent, n**	**Strength Coefficient, k, ksi**
	Transv.	**Transv.**	**Transv.**	**Transv.**
5083 H321	0.00505	11,300	0.155	79.2
5086 H32	0.00422	12,200	0.202	77.4
5383 H116	0.00505	11,500	0.158	81.9

The strain-hardening exponent ***n*** and the strength coefficient ***k*** are the parameters of the Ramberg-Osgood model of the true stress-strain curve

$$\varepsilon = \frac{\sigma}{E} + \left(\frac{\sigma}{k}\right)^{1/n} \qquad \text{(A-1)}$$

where

ε true strain = ln(1+ e)
σ true stress = s(1+ e)
e engineering strain
s engineering stress
E Young's Modulus.

The stress-strain curves are shown for 5083 H321, 5086 H32 and 5383 H116 in, respectively, Figures 39, 40 and 41.

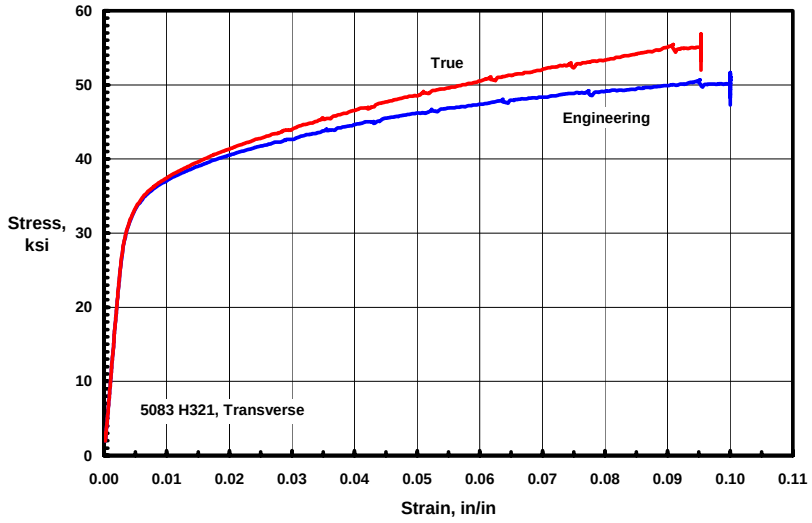

Figure 39. *5083 H321 – Transverse Stress-Strain Curves.*

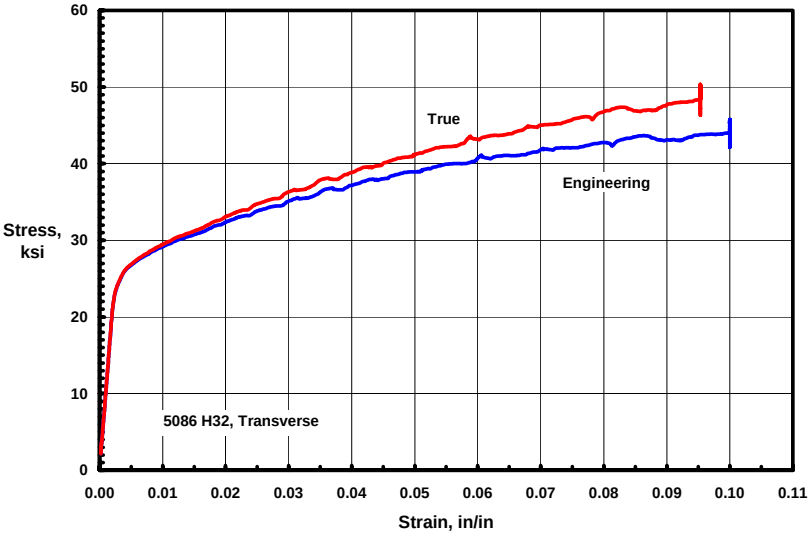

Figure 40. *5086 H32 – Transverse Stress-Strain Curves.*

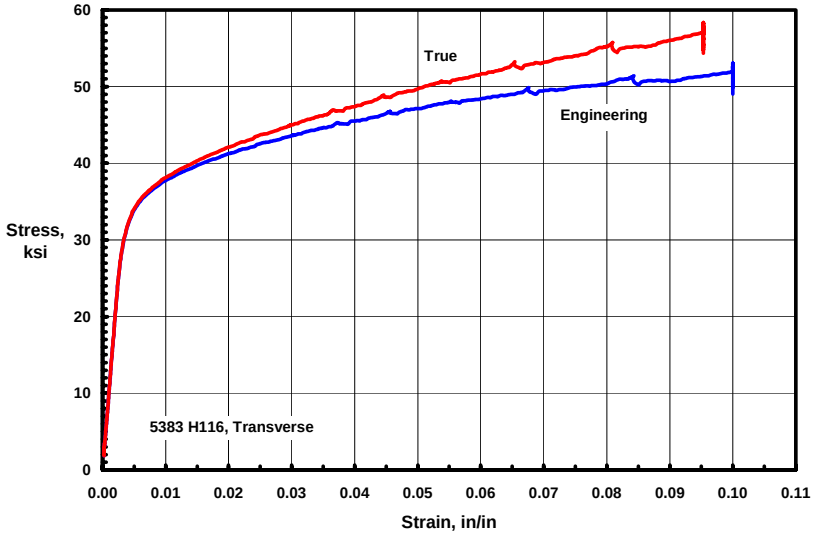

Figure 41. *5383 H116 – Transverse Stress-Strain Curves.*

Annex B – FCGR Methodology

AN INTEGRATED METHODOLOGY FOR SEPARATING CLOSURE AND RESIDUAL STRESS EFFECTS FROM FATIGUE CRACK GROWTH RATE DATA

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Abstract—To properly interpret the results of standard fatigue crack growth tests it is often necessary to incorporate corrective techniques to the ΔK applied data. This is especially true in the near-threshold regime where long crack data need to be closure corrected to predict small crack behavior. It is also an issue in the presence of residual stress. A methodology to separate the influence of sample size, geometry, crack length, and residual stress from the standard crack growth test data to obtain a true material response is presented. Stress ratio and residual stress contributions from known combinations of assumed crack size, applied stress, and residual stress are also addressed and incorporated in the fatigue crack growth behavior.

NOMENCLATURE

a	= crack length
a_i	= notch length before crack initiation
a_n, a_{n+1}	= current crack lengths measured at two successive steps n and n+1
da	= change in crack length
ACR	= adjusted compliance ratio
C_o	= $\Delta\delta_{app}/\Delta P$, compliance above the opening load
C_s	= $\Delta\delta_{eff}/\Delta P$, secant compliance
C_i	= $\Delta\delta_i/\Delta P$, compliance of the notch before crack initiation
E	= modulus of elasticity
n	= K_{max} sensitivity exponent
P_{max}	= maximum load
P_{min}	= minimum load
P_{op}	= opening load
P_0	= zero load
R	= ratio of mininum to maximum load or stress
$Z(a)$	= influence function
$d\delta$	= change in displacement due to change in crack length
$d\delta_{max}$	= change in displacement at maximum load due to change in crack length
$d\delta_{res}$	= change in displacement due to residual stress and change in crack length
$\Delta\delta_{max}$	= change in displacement at maximum load due crack advance from notch
$\Delta\delta_{app}$	= closure free displacement range
$\Delta\delta_{eff}$	= actual measured displacement range
$\Delta\delta_i$	= measured displacement range before crack initiation
$\Delta\delta_{cl}$	= $\Delta\delta_{app} - \Delta\delta_{eff}$, displacement difference due to closure
K	= stress intensity factor
K_{res}	= stress intensity due to residual stress
K_{max}	= maximum stress intensity
K_{norm}	= normalized stress intensity
ΔK	= stress intensity range
ΔK_{app}	= applied stress intensity range
ΔK_{eff}	= effective stress intensity range
ΔK_{cl}	= $\Delta K_{app} - \Delta K_{eff}$, stress intensity reduction due to closure

Fatigue & Fracture of Engineering Materials – Special Issue Contribution (in press)

INTRODUCTION

Steady-state fatigue crack growth data generated for long cracks (corresponding to fatigue crack growth testing conducted on compact tension C(T), middle tension M(T), etc. specimens) can be altered by various external effects and often do not represent the true behavior of the material investigated. Such effects have various origins. One is related to the existence of closure mechanisms, active behind the crack tip, which create differences between long crack growth data (ΔK_{app}) and naturally initiated or small crack growth data (ΔK_{eff}) and can lead to non-conservative estimations of fatigue life. Another source of errors when incorporating long crack growth data in design is associated with the presence of externally induced (or global) compression or tension residual stresses [1,2,3]. In this case, sample size and/or geometry can produce variability in the data generated on virtually identical materials, and crack length can also play an important role. Numerous attempts to resolve these issues and normalize data generated under various specimen/testing conditions have been made in the past, but no comprehensive method able to appropriately handle all these effects has yet been proposed. Thus, in this study, a methodology able to successively handle these effects is proposed.

PROPOSED METHODOLOGY

The methodology correlates fatigue crack growth rate (FCGR) data from samples with either tensile, compressive or no residual stress using a combination of compliance measurement techniques, K-control, adjusted compliance ratio (ACR) crack closure measurement techniques, on-line crack-compliance K residual calculations and K_{max} sensitivity concepts. The resulting FCGR curve is a material property response that has been de-coupled from the confounding effects of crack length, test coupon geometry and residual stress. As opposed to the traditional life prediction models, this methodology uses normalized data representative of a zero stress ratio ($R = 0$) with no remote closure (small crack behavior). Stress ratio effects can be further incorporated in fatigue crack growth data by back calculating ΔK_{eff} from the normalized K. Although it is believed that this approach gives the most reliable life prediction methodology, it is difficult to compare this process to more traditional methods since evaluations of residual stress and remote closure are generally not obtained during standard crack growth rate tests.

There are two fundamental reasons why data from large samples with long cracks may not be representative of the crack growth behavior of small cracks:

1) In the presence of global residual stress (for example, caused by quenching as part of heat treatment), the larger the sample size relative to the original component, the greater the degree of residual stress captured in the machined sample. Also, edge crack samples and center crack samples generally exhibit different behavior if extracted from the same location within the original component.

2) The larger the sample and crack size, the smaller the applied stress for a given stress intensity. This point serves to amplify both the effects of remote closure and residual stress compared to test coupons with smaller crack sizes and higher stresses.

It is proposed that for common long crack test samples, a proper analytical evaluation of the fatigue crack growth rate data involves the following steps:

1. Generate da/dN data using compliance measurement techniques and K-control.
2. Determine the effective stress intensity using the ACR method.
3. If possible, adjust for residual stress using the on-line crack-compliance method.

4. Use K_{max} sensitivity concepts to incorporate residual stress effects into the normalized (or master) crack growth rate curve.
5. Reintroduce stress ratio effects into the master curve from the knowledge of crack size, applied stress and residual stress in the structure.

Each of these steps will be detailed below:

1. Compliance measurement and K-control

K-control methodology offers advantages for fatigue crack growth data generation and uses a constant value of the expression (1/K)·(dK/da) to control the K profile. A negative value of this expression is used for decreasing K (near-threshold) and a positive value for increasing K (mid to upper Region II and Region III). This effectively results in a greater ΔK range over the same increment of crack extension. The details on the K-control procedure suggested in ASTM E647 were first performed in the 1970's (see Ref. [4]). Experience has shown this procedure substantially reduces the test time and cost necessary to generate fatigue crack growth data with no adverse impact on the test result.

When practical, the compliance method of monitoring crack length is used. The method has the advantage of higher resolution than either visual methods or the indirect potential drop method (foil gages) because the method averages the through-the-thickness crack length instead of the somewhat more discontinuous growth of the crack on the surface. When sample type and test temperature permit, the compliance method is generally preferred because of the added advantage that crack closure can be evaluated. Both the ASTM 2% offset opening load method [5] and the adjusted compliance ratio (ACR) method [6] are based on compliance data. The non-visual crack length measurement methods should be complemented by periodic visual measurements of the crack, both for validity purposes and for post-test analysis corrections to the original raw data.

Besides the commonly recognized closure mechanisms, macro residual stress-crack closure may significantly influence fatigue crack growth rate data. Therefore, in addition to measuring crack closure (using compliance measurements), notch closing or opening measurements are recommended on compact tension, C(T), samples before and after machining the notch as a means of evaluating/separating the individual influence of residual stress on/from the crack growth rate behavior. The significance of this statement including the impact of these observations on fatigue crack growth rates can be found elsewhere [7].

2. Adjusted Compliance Ratio (ACR) method

Since Elber introduced the concept of crack closure, it has become a widely used tool to explain the extrinsic response of fatigue crack growth rate behavior. Crack closure is a crack tip shielding mechanism whereby the crack-tip cyclic strain is partially shielded from damaging stress. The source of this shielding is most commonly caused by crack wake interference due to roughness (microstructure), oxides, plasticity, and/or residual stress. The experimental measurement of crack closure has been hampered by widely varying and non-repeatable methods of evaluation. Furthermore, experimental observations are subject to varying and inconsistent methods of interpretation. In an attempt to improve consistency of measurement, ASTM E647 has introduced an automated offset opening load technique. After two round-robin programs, this method was adopted as an annex to the ASTM E647 standard. However, this method often overcorrects the ΔK applied data primarily because the method fails to account for evidence of crack tip cyclic strain below the opening load [6]. This is especially important if the closure mechanism is not necessarily near the crack tip but distributed along the full wake of the crack or near the notch.

The ACR method of determining the effective stress intensity has been useful in accounting for compressive residual stress and other sources of remote closure resulting in an intrinsic FCGR curve that is thought to emulate small crack growth behavior. The method uses the same load-displacement records as the opening load method, but it accounts for partial closure effects (effects below the opening load). The assumption of crack tip activity below the opening load is most relevant at opening loads that are a large fraction of the applied load, such as the near-threshold regime. The ACR technique attempts to account for strain fields at the crack tip, below K_{op}, caused by interaction of the mating broken faces along the crack wake. Below K_{op}, the interference strains induce an additional K at the crack tip, which is added to the K_{min}, thus reducing the ΔK_{eff}, while above K_{op} only the applied force contributes directly to K_{app}.

This method estimates ΔK_{eff} using the ratio of the actual displacement range ($\Delta\delta_{eff}$) to the displacement range that would have occurred in the absence of closure ($\Delta\delta_{app}$) (Figure 1). This method uses remote (front face) displacement measurements because the local crack tip strain is impractical or impossible to obtain. The displacements are a "quantitative" measure of the "qualitative" strain activity of the broken surfaces in the crack wake. Displacement measurements are evaluated relative to the original displacement of the notch at the beginning of the test, and therefore the adjusted compliance ratio is calculated by subtracting the initial notch displacement from both displacements in the presence and the absence of closure:

$$ACR = (\Delta\delta_{eff} - \Delta\delta_i)/(\Delta\delta_{app} - \Delta\delta_i) \quad (1)$$

Converting to compliance, the expression for ACR becomes:

$$ACR = (C_s - C_i)/(C_o - C_i) \quad (2)$$

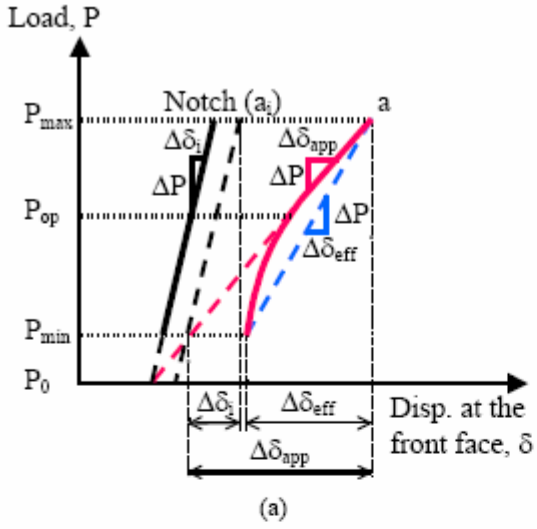
where

$C_s = \Delta\delta_{eff}/\Delta P$ is the secant compliance
$C_o = \Delta\delta_{app}/\Delta P$ is the compliance above the opening load
$C_i = \Delta\delta_i/\Delta P$ is the compliance of the notch before crack initiation

Once ACR is determined, ΔK_{eff} can be calculated as:

$$\Delta K_{eff} = ACR \cdot \Delta K_{app} = \frac{\Delta\delta_{eff} - \Delta\delta_i}{\Delta\delta_{app} - \Delta\delta_i} \cdot \Delta K_{app} = \frac{C_s - C_i}{C_o - C_i} \cdot \Delta K_{app} \quad (3)$$

Experimental evidence shows that when the initial un-cracked compliance, C_i, is subtracted from both the numerator and denominator of the compliance ratio, the resulting ACR is measurement-location insensitive [6]. The similarity between the ACR method and the on-line crack compliance method (see Ref. 8 and Section 4) is shown in Figures 1 and 2. Either method gives an identical result for the calculation of ΔK_{eff}. In the first case, Figure1, ΔK_{eff} is calculated directly from the ratio of compliances. In the second case, Figure 2, ΔK_{cl} is calculated directly and then subtracted from ΔK_{app} to determine ΔK_{eff}.



$$\Delta K_{eff} = ACR \cdot \Delta K_{app}$$

where

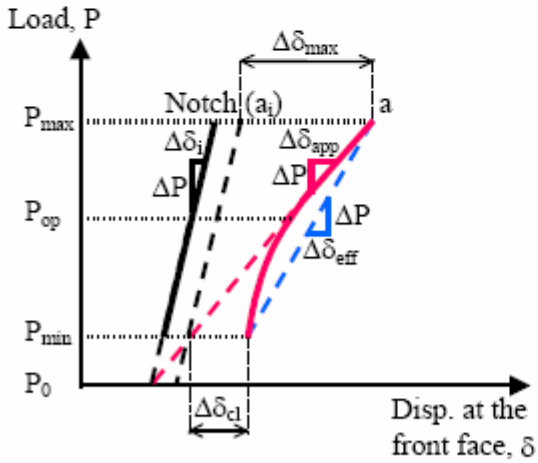
$$ACR = \frac{\Delta\delta_{eff} - \Delta\delta_i}{\Delta\delta_{app} - \Delta\delta_i}$$

or

$$ACR = \frac{C_s - C_i}{C_o - C_i}$$

(b)

Fig. 1. (a) Load-displacement records showing the critical parameters in the ACR method [6,10]; (b) equations used in the ACR method.



$$\Delta K_{eff} = \Delta K_{app} - \Delta K_{cl}$$

where

$$\Delta K_{cl} = \Delta K_{app} \cdot \frac{\Delta\delta_{cl}}{\Delta\delta_{max}}$$

$$\frac{\Delta K_{cl}}{\Delta K_{app}} = 1 - ACR = 1 - \frac{\Delta K_{eff}}{\Delta K_{app}}$$

(b)

Fig. 2. (a) Load-displacement records showing the parameters used in the on-line crack-compliance technique for global closure correction; (b) equations used in the on-line crack-compliance technique for global closure correction.

Recently, a fracture mechanics based analysis providing mathematical foundation for residual stress and crack closure correction methodologies has been developed [8], and good agreement between this analysis and the ACR method was observed. It should be noted that the complexity and the unknown distribution of forces in the crack wake combined with the increasingly larger increments of crack extension used for calculating the ACR make the solution a good approximation rather than an exact solution. The effectiveness of the ACR method has been demonstrated in two recent publications [9,10], which show good correlations between small crack growth data and ACR corrected long crack growth data. The data from reference [9] uses an open-hole corner crack sample whereas the data from reference [10] employs axially loaded corner-crack specimen geometry. Figure 3 [from Ref. 10] shows that the small crack data (triangles) closely matches the ACR corrected data from the long crack sample (stars). This figure also shows the lack of correlation between small crack behavior and the ASTM 2% offset opening load method (squares).

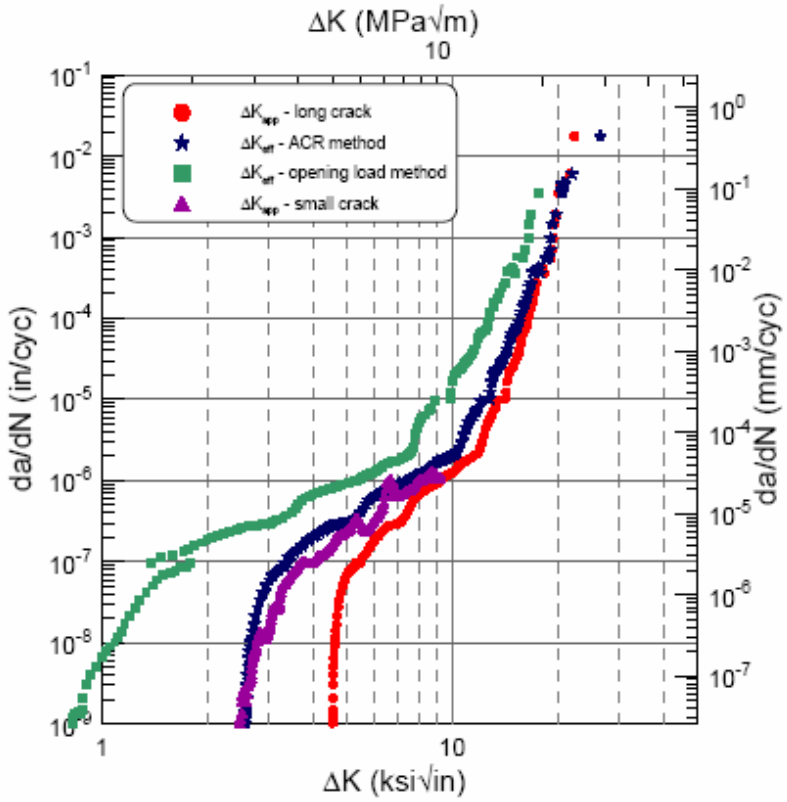


Fig 3. Comparison of long crack data, small crack data, and closure corrected data (R=0.1) for an Al-7%Si-0.45%Mg cast alloy [10] (circles = uncorrected long crack growth data; triangles = small crack growth data; stars = ACR corrected long crack growth data; squares = opening load corrected long crack growth data).

3. Real-time determination of K_{res} using on-line crack-compliance method

Recent advances in fracture mechanics derivations for closure corrections [8] have remarkably improved the understanding of the ACR closure concept with notable similarities between this concept and the cut-compliance method [7,11,12] for determining K_{res}. The on-line crack-compliance method of determining K_{res} during a crack growth test [8] is also similar to the cut-compliance method [7,11], but it can be applied during testing and without using influence functions. This is the result of the advances in the understanding of the ACR methodology and experimental evidence that both the on-line crack-compliance method and the ACR method are indeed measurement location insensitive.

The cut-compliance method of computing the stress intensity due to residual stress, K_{res}, was developed by Schindler [11] and is based on Castigliano's theorem. However, new influence functions have been developed [7,8] using front-face displacements instead of back-face strains:

$$K_{res} = \frac{E}{Z(a)} \cdot \frac{d\delta}{da} \qquad (4)$$

The new on-line crack-compliance technique can be applied by extrapolating the slope of the load-displacement curve down to a displacement corresponding to zero load and paying careful attention to signal stability and load-displacement linearity. As the crack advances, a decrease in displacement at zero load indicates a compressive (negative) K_{res} whereas an increase signifies tensile (positive) K_{res}. Tensile residual stress determination is straightforward since the tendency of the crack to open minimizes crack closure effects (Figure 4(a)). Compressive residual stress can also be measured as long as the slope of the load-displacement curve is determined above the closure level (Figure 4(b)). K_{res} can be determined by measuring the change in displacement (or strain) at maximum load for a given increment of crack extension and comparing this to the corresponding change in displacement (or strain) at zero load over the same increment of crack extension. The ratio of the displacement change at zero load ($d\delta_{res}$) to the displacement change at maximum load ($d\delta_{max}$) multiplied by K_{max} provides the K_{res} as shown below [8]:

$$K_{res} = K_{max} \cdot \frac{d\delta_{res}}{d\delta_{max}} \qquad (5)$$

As mentioned earlier, the on-line crack-compliance technique can be applied without the need to calculate influence functions, Z(a). It needs to be noted that both this approach and the ACR method are based on ratios of displacements and they are convenient to use due to their simplicity. Since a ratio of displacements is used to calculate K_{res}, the displacements need not be measured at the load-line. The practical application of this methodology requires sufficient signal stability and linearity to determine K_{res}. Furthermore, predominately elastic behavior is assumed since the influence of the crack tip plastic zone would contribute to erroneous calculations of K_{res}.

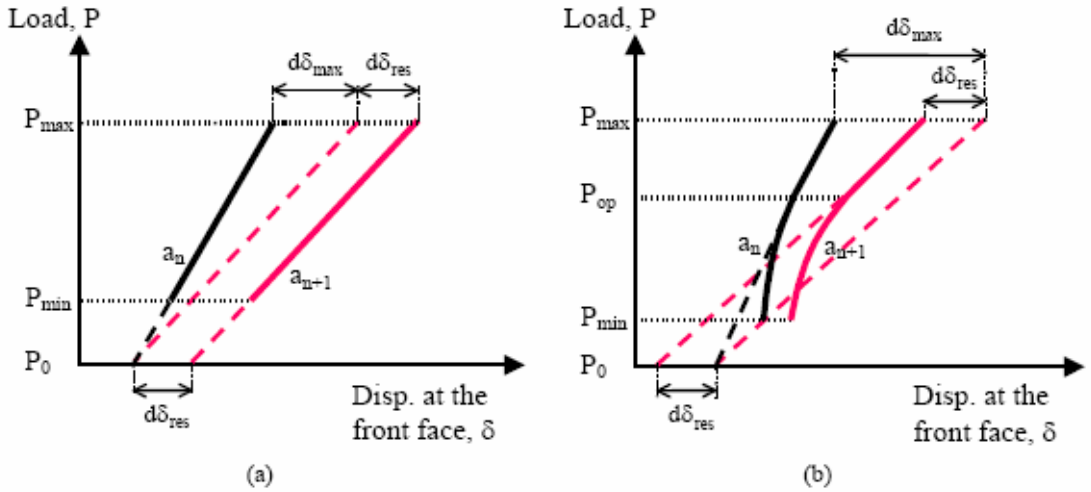


Fig. 4. Load-displacement records showing the critical parameters in the on-line crack-compliance residual measurement technique [8]: (a) tensile residual stress and (b) compressive residual stress; the dashed lines parallel with the a_{n+1} load-displacement (or tangent to the load-displacement) records represent residual stress free conditions.

4. K_{max} sensitivity

Compressive residual stress has a direct impact on the crack tip driving force, ΔK, especially at low stress ratios and at near-threshold crack growth rates. Tensile residual stress may only affect K_{max} since the crack can remain fully open even at the minimum load. Regardless of whether or not compressive or tensile residual stresses are present, correlating stress ratio effects using the ACR method often results in the observation that the FCGR response is determined not only by ΔK_{eff} but it also depends on K_{max}. It was also observed that this K_{max} dependence takes the form of a power law with the magnitude of the exponent being a measure of K_{max} sensitivity [13].

An earlier investigation of 2000, 6000, and 7000 series wrought aluminum alloys [14] has revealed a second order K_{max} effect that covers a wide range of crack growth rate data and stress ratios, Figure 5(a). In a similar manner to that proposed by Walker [15], a unique intrinsic FCGR curve can be obtained by normalizing the stress intensity according to the equation:

$$K_{norm} = \Delta K^{1-n} \cdot K_{max}{}^{n} \qquad (6)$$

An empirically derived K_{max} sensitivity exponent n = 0.25 was shown to "collapse" the data, Figure 5(b) (see Ref. [10]). In order to correctly incorporate this K_{max} sensitivity concept, it is necessary to first determine the effective stress intensity using the ACR method. Then K_{res} needs to be added to K_{max} applied to give the total K in the K normalization process. Equation (6) then becomes:

$$K_{norm} = \Delta K_{eff}{}^{1-n} \cdot K_{max+residual}{}^{n} \qquad (7)$$

The K_{max} sensitivity concept is intended to compensate for the interaction between ΔK and K_{max} under predominately elastic conditions and does not apply to Region III behavior. A methodology to correct Region III FCGR data for plasticity can be found elsewhere [16]. The magnitude of the K_{max} sensitivity exponent may vary according to material and environmental conditions. The correlation illustrated in this example may not apply as accurately to all combinations of growth rates and stress ratios for other material-environment systems.

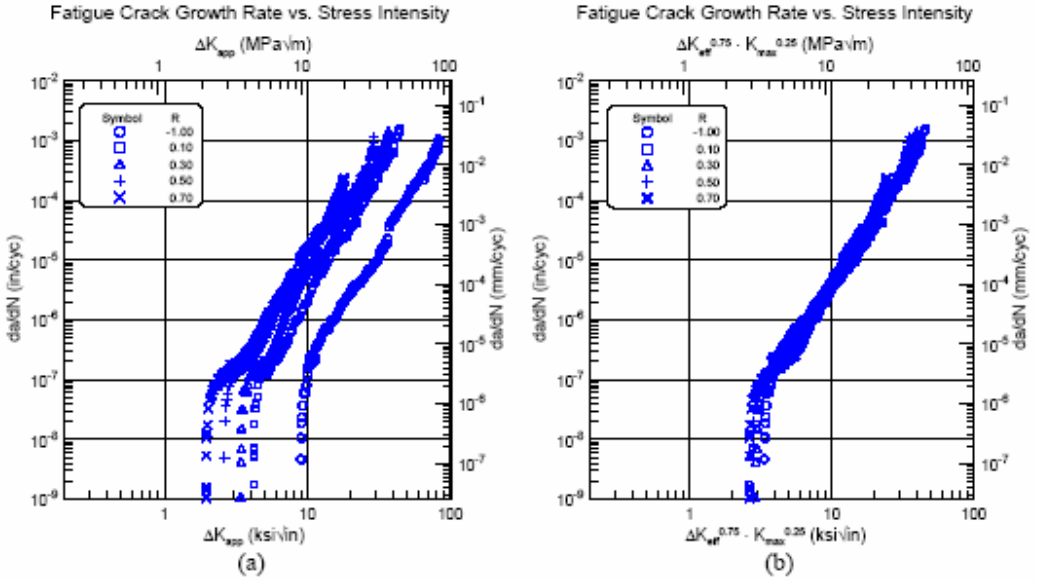


Fig. 5. Fatigue crack growth data of 2324-T39 Al showing: (a) ΔK_{app} and (b) K_{norm} after ACR correction.

5. Re-introducing stress ratio effects

The normalization process masks the effect of stress ratio, residual stress, and remote closure. Since remote closure is also affected by a combination of sample size and geometry, the resulting FCGR response is expected to be a good indicator of the material property for a physically small crack as long as the elastic K analysis is still valid. The physically small crack is larger than the mechanically small crack (where K is no longer valid) and the micro-structurally small crack (where behavior is governed by micro-structural constituents on the order of the crack size). The normalization process is not expected to mask out material property details such as orientation, environment or toughness-related behavior associated with upper Region II and Region III behavior. Thus, the normalization process allows a direct comparison between the responses of different materials and different environments.

In order to apply the normalized curve into a life prediction process, it is necessary to reintroduce the stress ratio effect and solve for ΔK. Recognizing that:

$$K_{max} = \frac{\Delta K}{(1-R)} \tag{8}$$

Equation (7) can be rearranged to solve for ΔK_{eff} as shown in equation (9):

$$\Delta K_{eff} = K_{norm} \cdot (1 - R)^{\alpha} \qquad (9)$$

Equation (9) re-evaluates a curve for each stress ratio of interest from the single normalized curve. Figure 6(a) shows the effect of stress ratio (R = 0.1, 0.3, 0.5, and 0.7) after correcting for closure using the ACR method. In Figure 6(b), the stress ratio effect has been re-introduced using equation (9) for the normalized curved tested at a stress ratio R=0.1. After re-processing, Figure 6(b), data initially corresponding to one stress ratio closely match the data provided by the tests done under four different stress ratios (Figure 6(a)). Determining the proper stress ratio also requires knowledge of the applied stress and the residual stress for the structure.

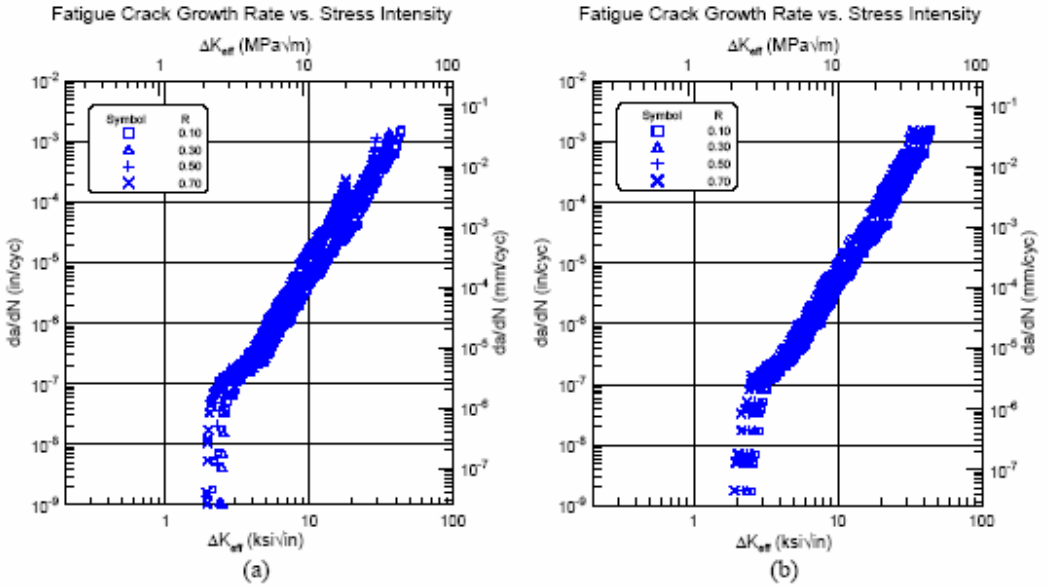


Fig 6. Fatigue crack growth curves showing: (a) original ΔK_{eff} data (using ACR method) and (b) ΔK_{eff} data from single normalized curve after re-introducing stress ratio effect.

SUMMARY

A methodology has been presented to assist in providing a unique intrinsic FCGR curve that is thought to emulate small crack growth behavior of a material. The proposed methodology should be considered a guideline since for several applications some of the presented techniques may be impractical (for example, compliance measurement on samples with small cracks or aggressive environments is often impractical). The ACR methodology is presented as a useful and easy to implement tool to compensate for closure contributions and to determine the small crack growth behavior. On-line K_{res} measurements are considered appropriate means to account for residual stress contributions as long as a high level of instrumentation precision, stability, and linearity can be achieved. K_{max} sensitivity corrections are introduced to broaden the usefulness of the methodology for life prediction since the FCGR curve (excluding Region III) can be normalized and expressed as a unique curve regardless of the stress ratio. A procedure to re-introduce stress ratio effects is also presented to allow the use of normalized data for life prediction.

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Annex C – Photographs of Test Samples


5083-FT-3
5083-FT-3
5086-FCG-1
5086-FCG-1
5086-FCG-2
5086-FCG-2
5086-FCG-3
5086-FCG-3
5086-FCG-4
5086-FCG-4
5086-FCG-5
5086-FCG-5
5086-FT-1
5086-FT-1
5086-FT-2
5086-FT-2


5086-FT-3
5086-FT-3
5383-FCG-1
5383-FCG-1
5383-FCG-2
5383-FCG-2
5383-FCG-3
5383-FCG-3
5383-FCG-4
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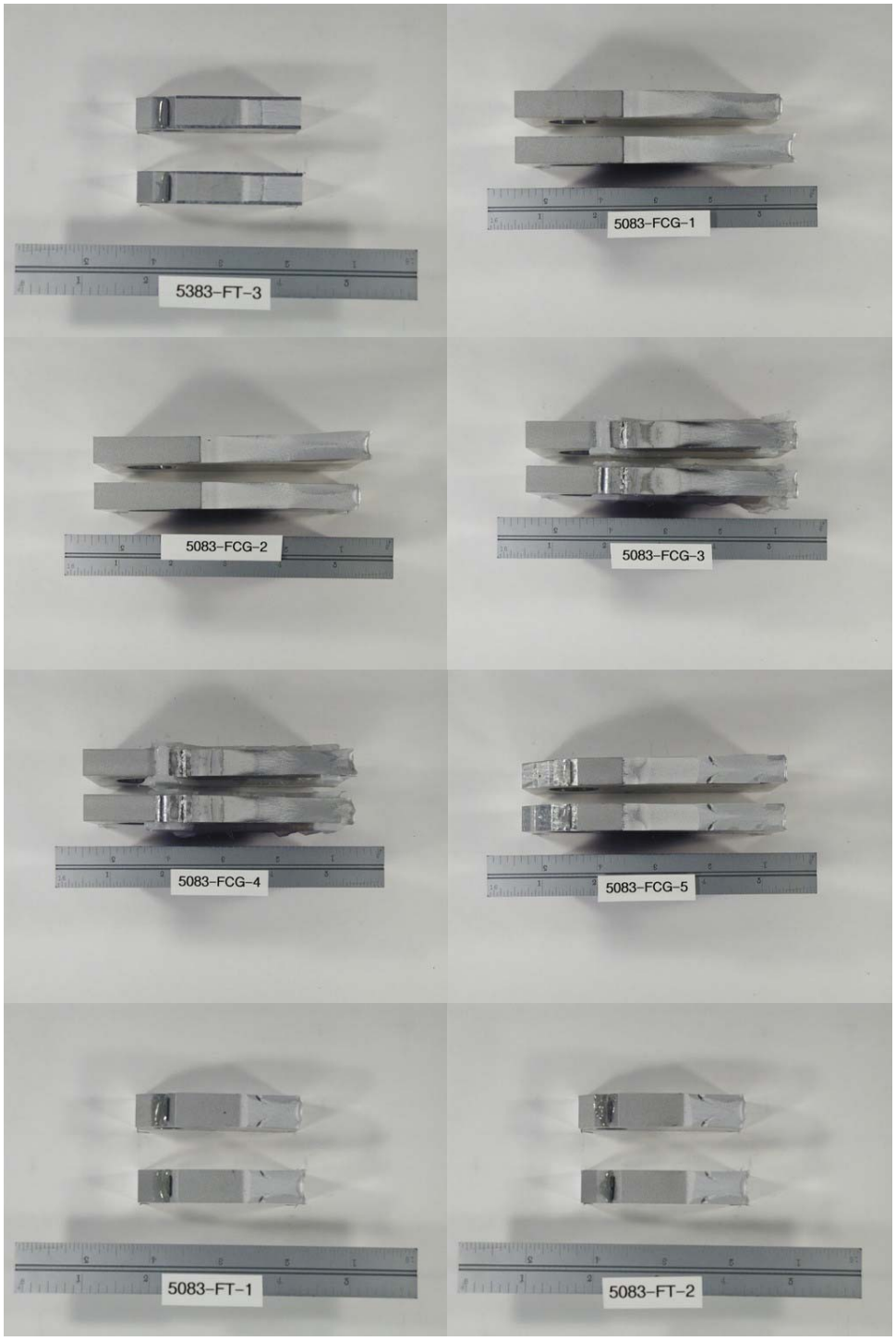
5383-FT-2
5383-FT-2


5383–FT–3
5083–FCG–1
5083–FCG–2
5083–FCG–3
5083–FCG–4
5083–FCG–5
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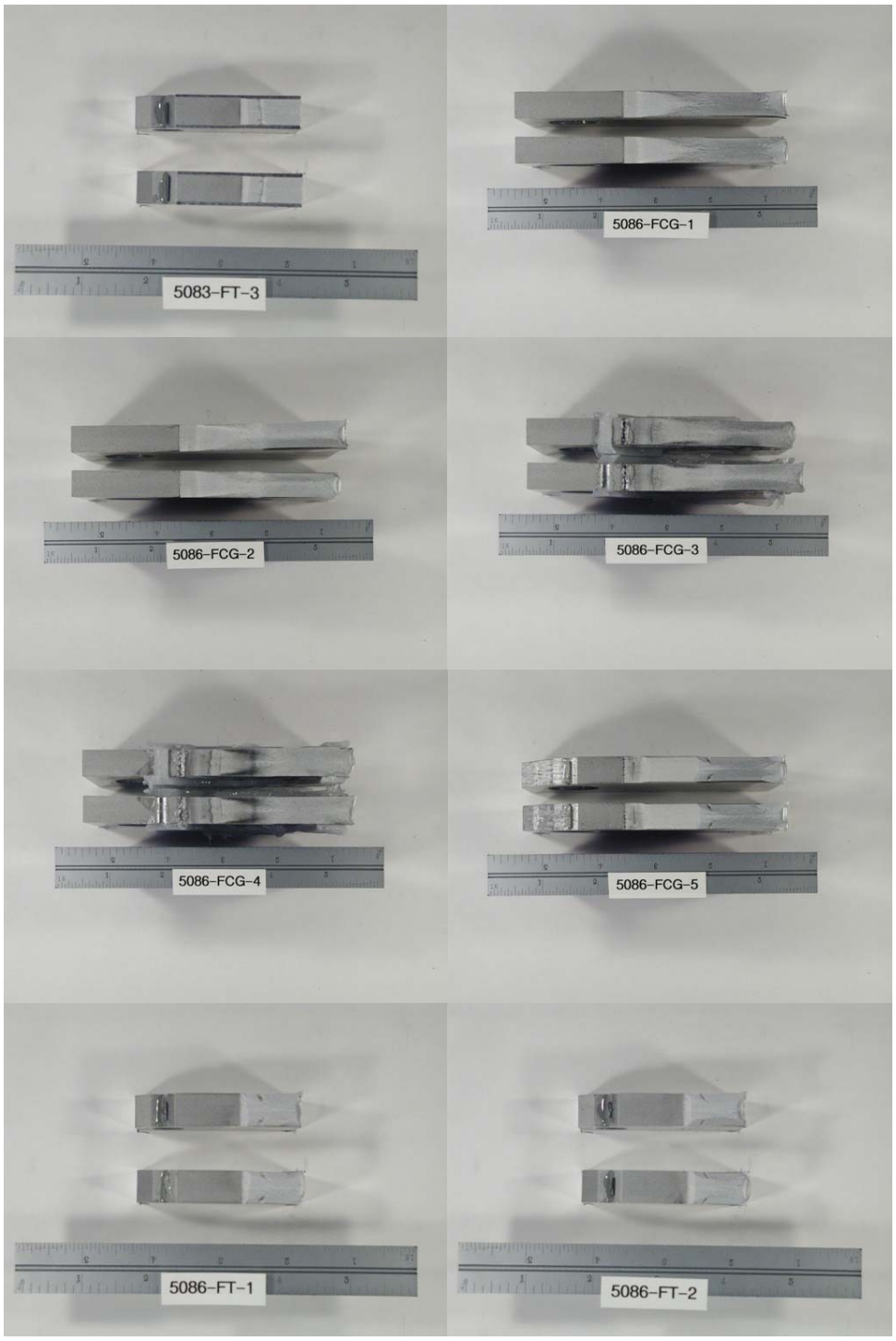
5083–FT–2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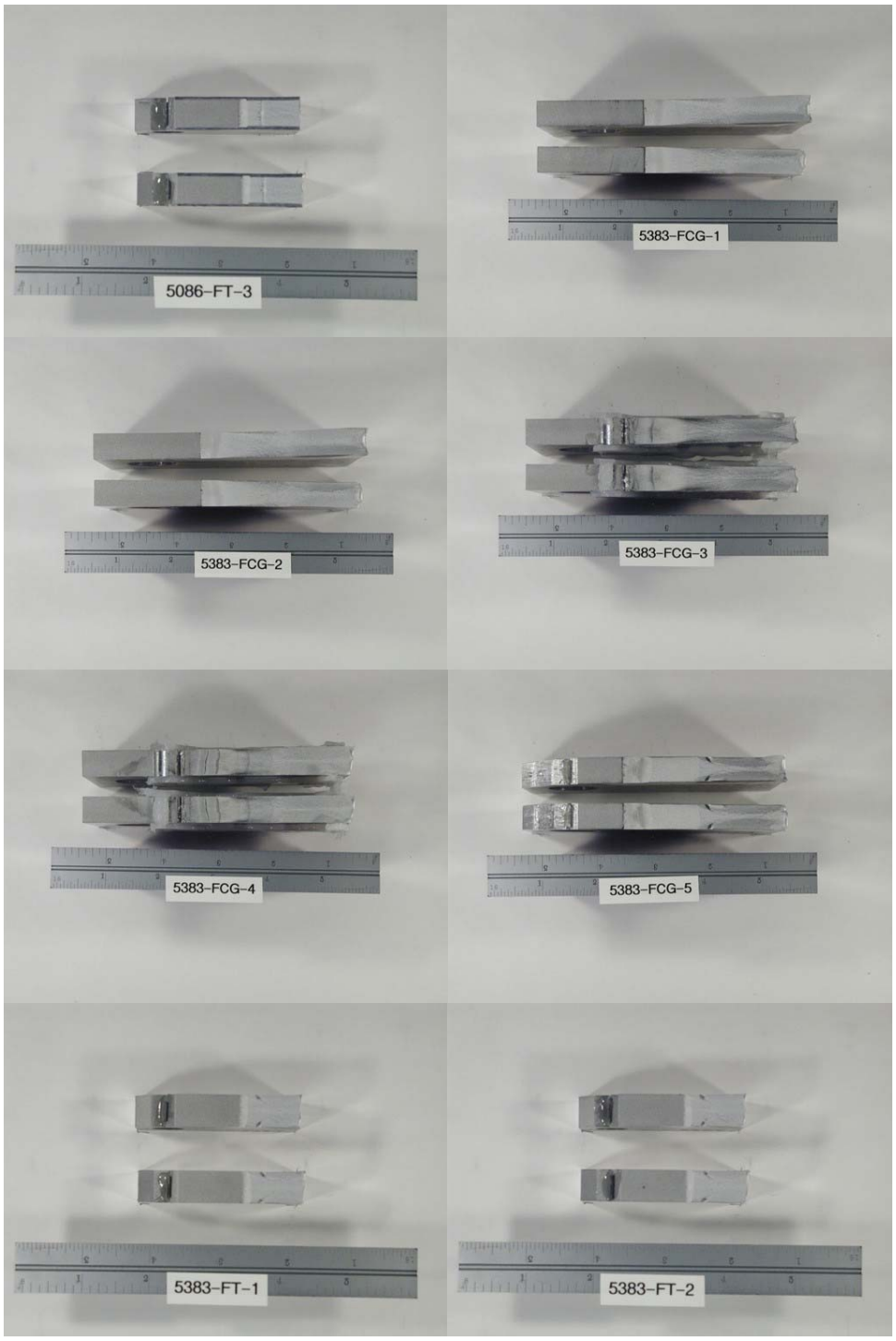
5086-FCG-3
5086-FCG-4
5086-FCG-5
5086-FT-1
5086-FT-2


5086-FT-3
5383-FCG-1
5383-FCG-2
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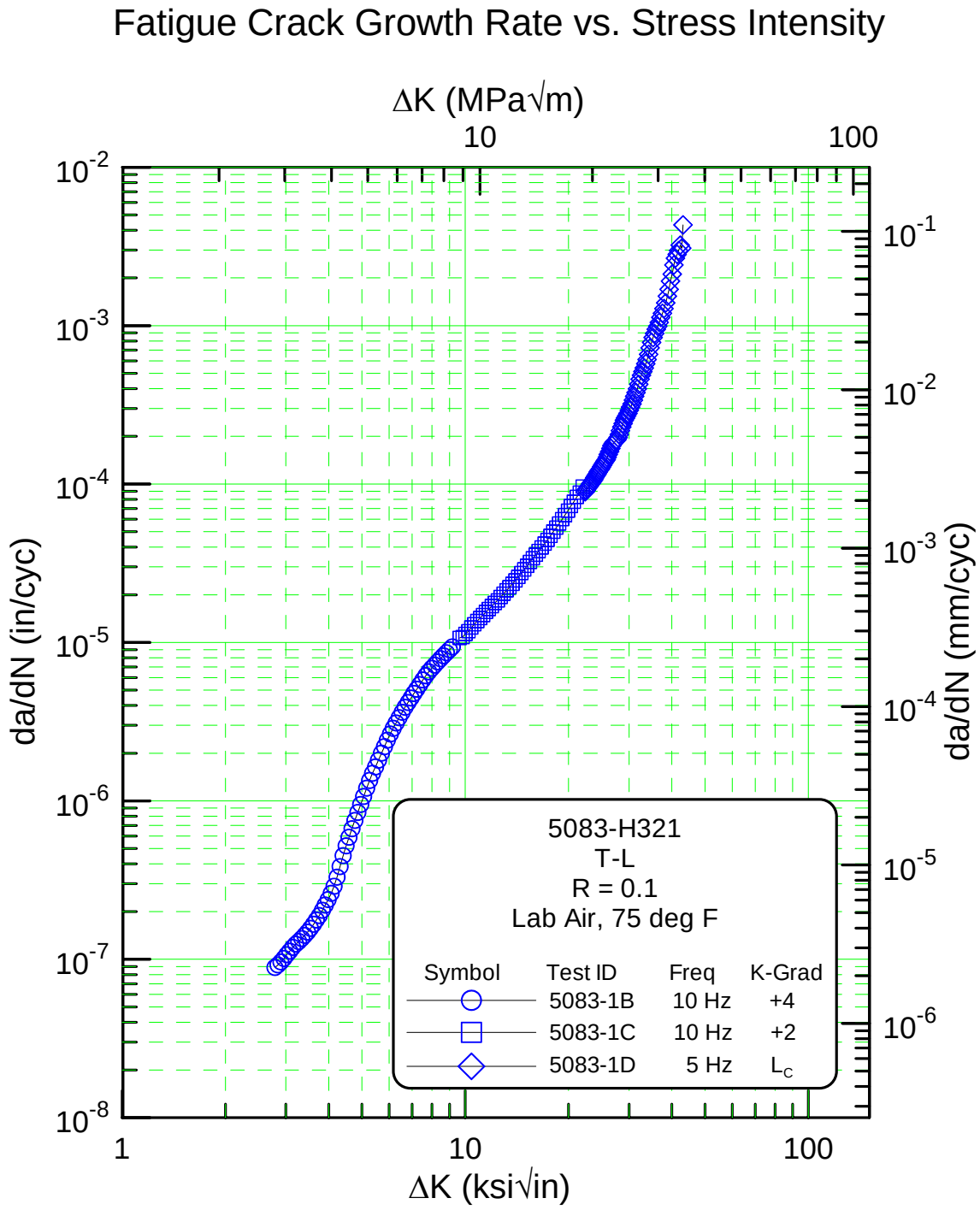
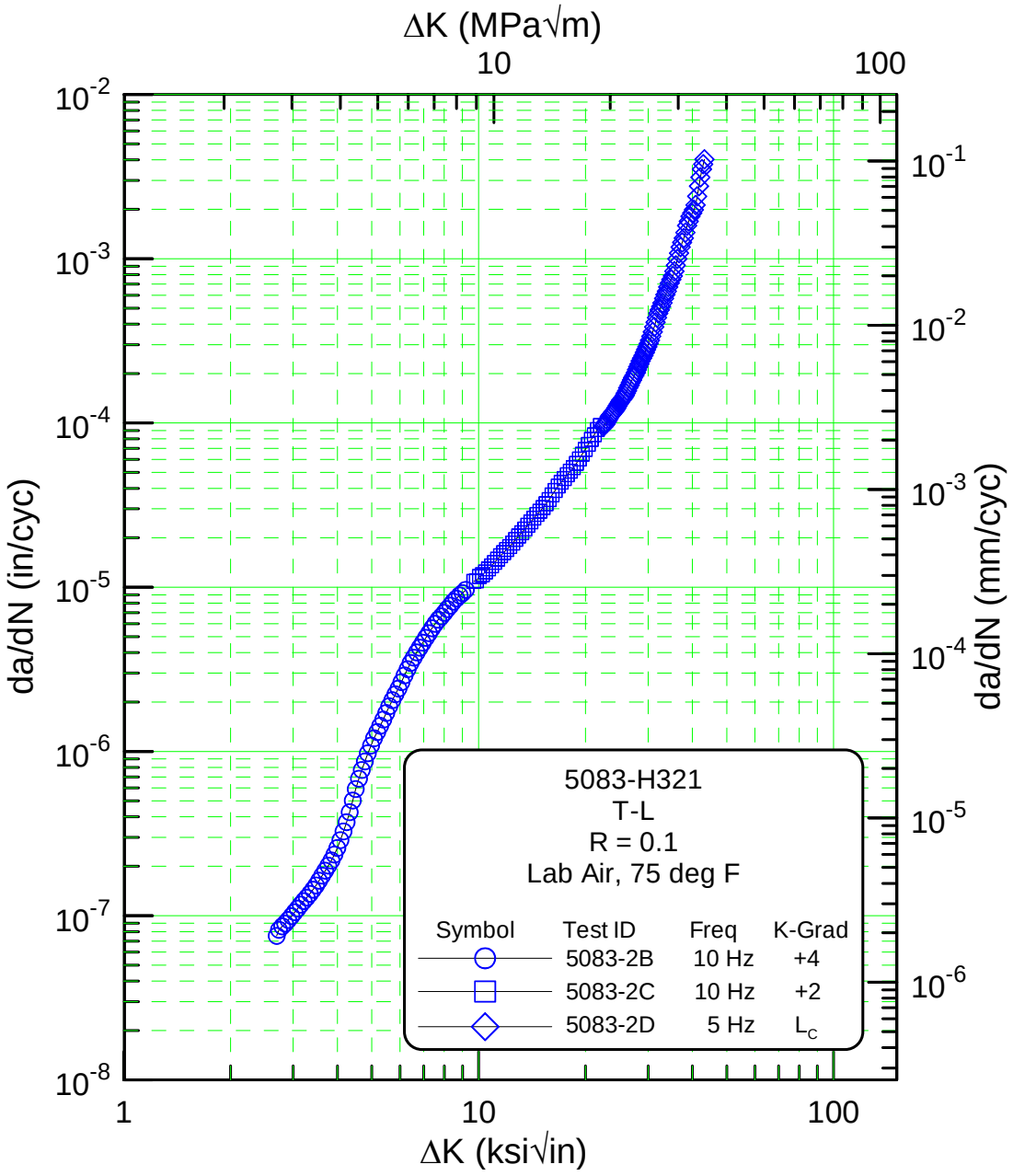
Annex D – Individual FCGR Curves



Fatigue Crack Growth Rate vs. Stress Intensity



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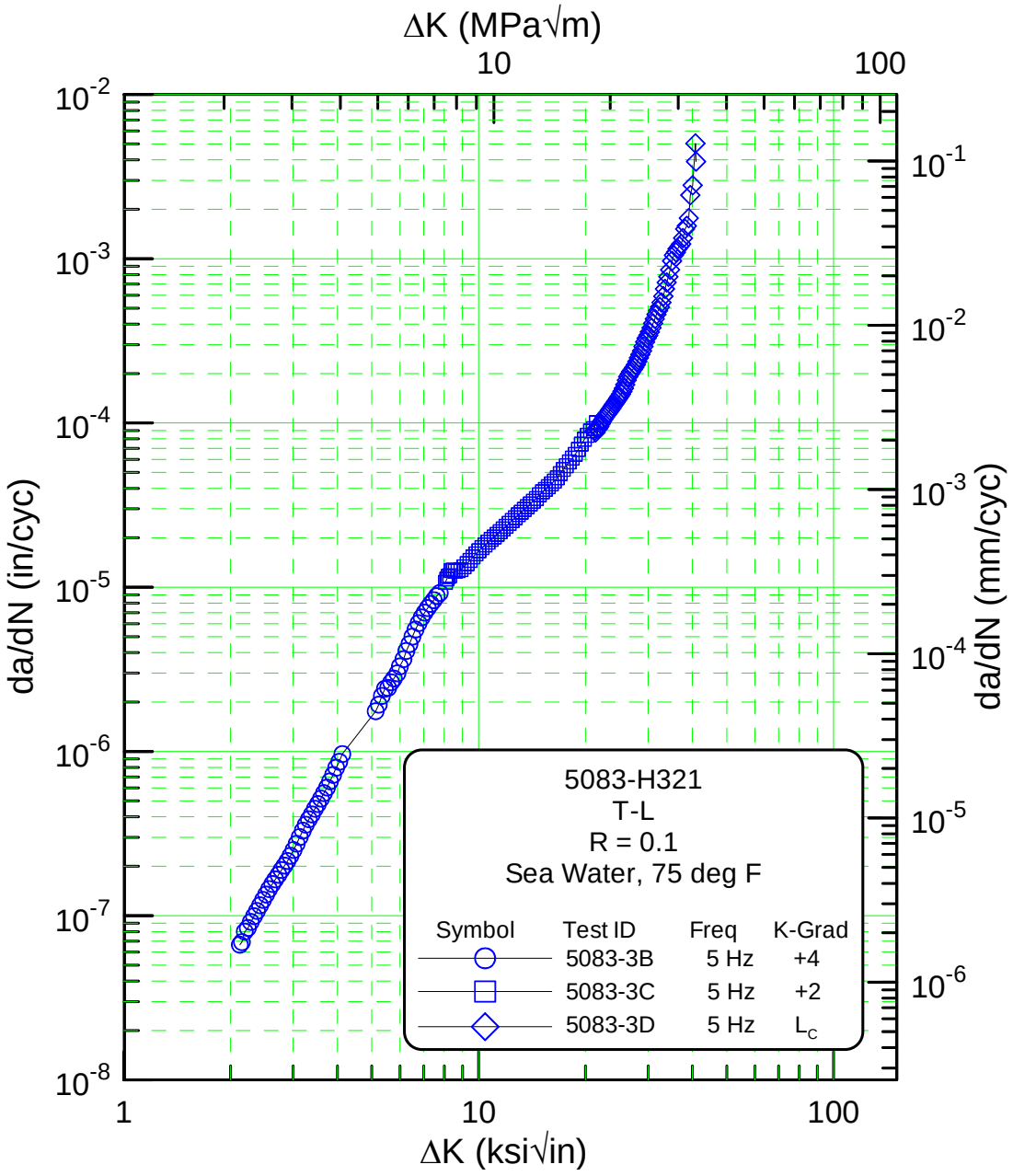

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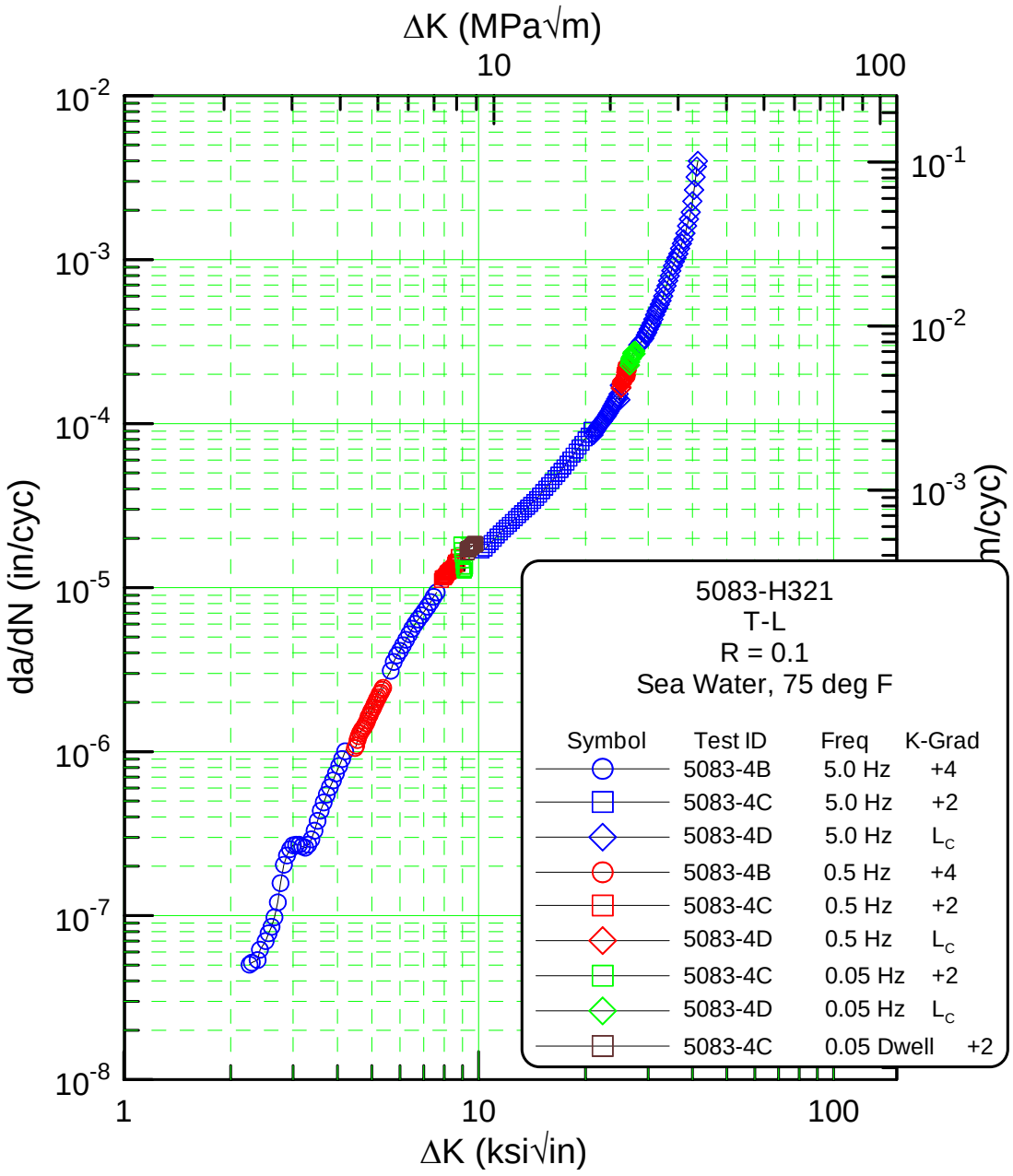

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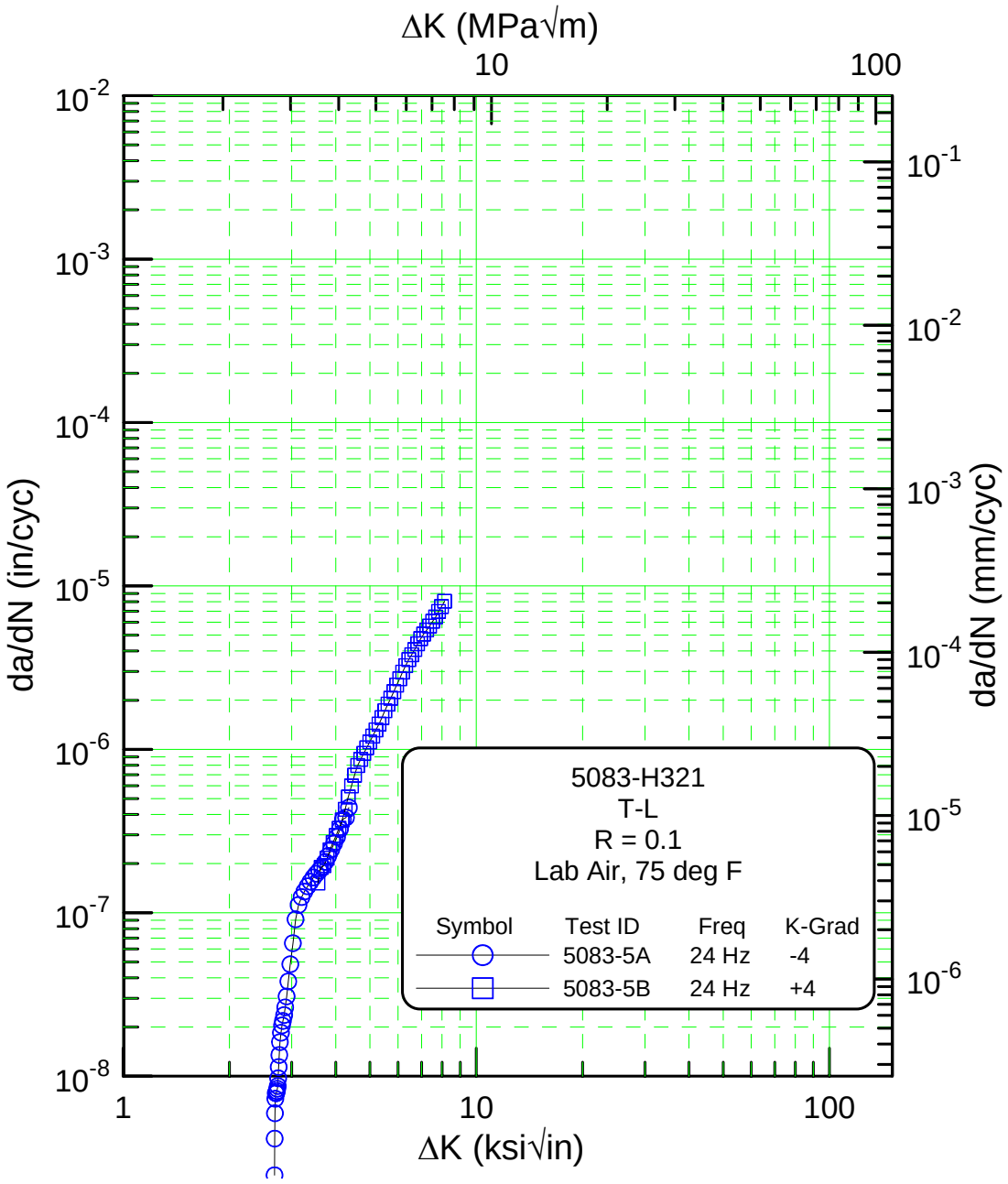
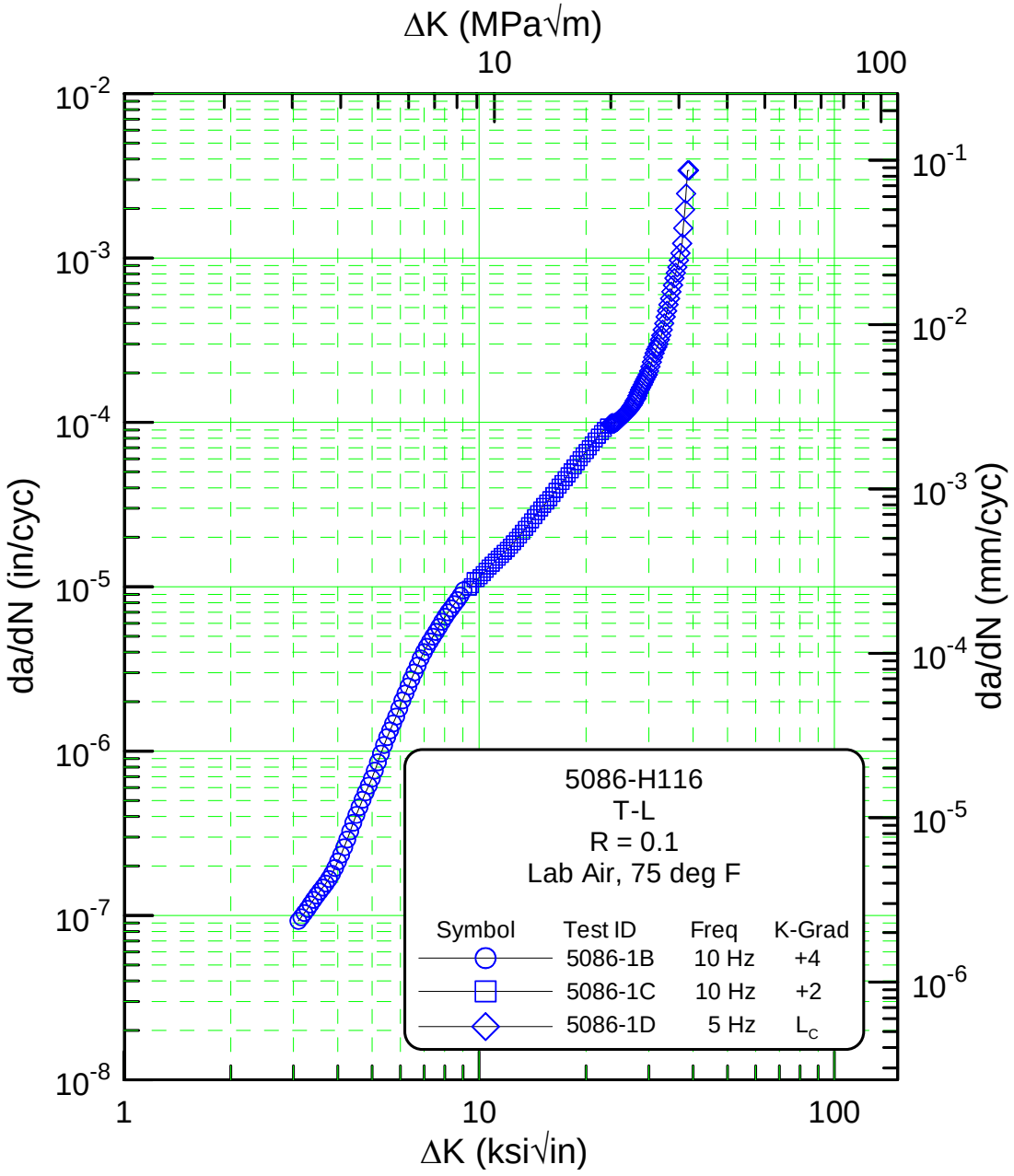
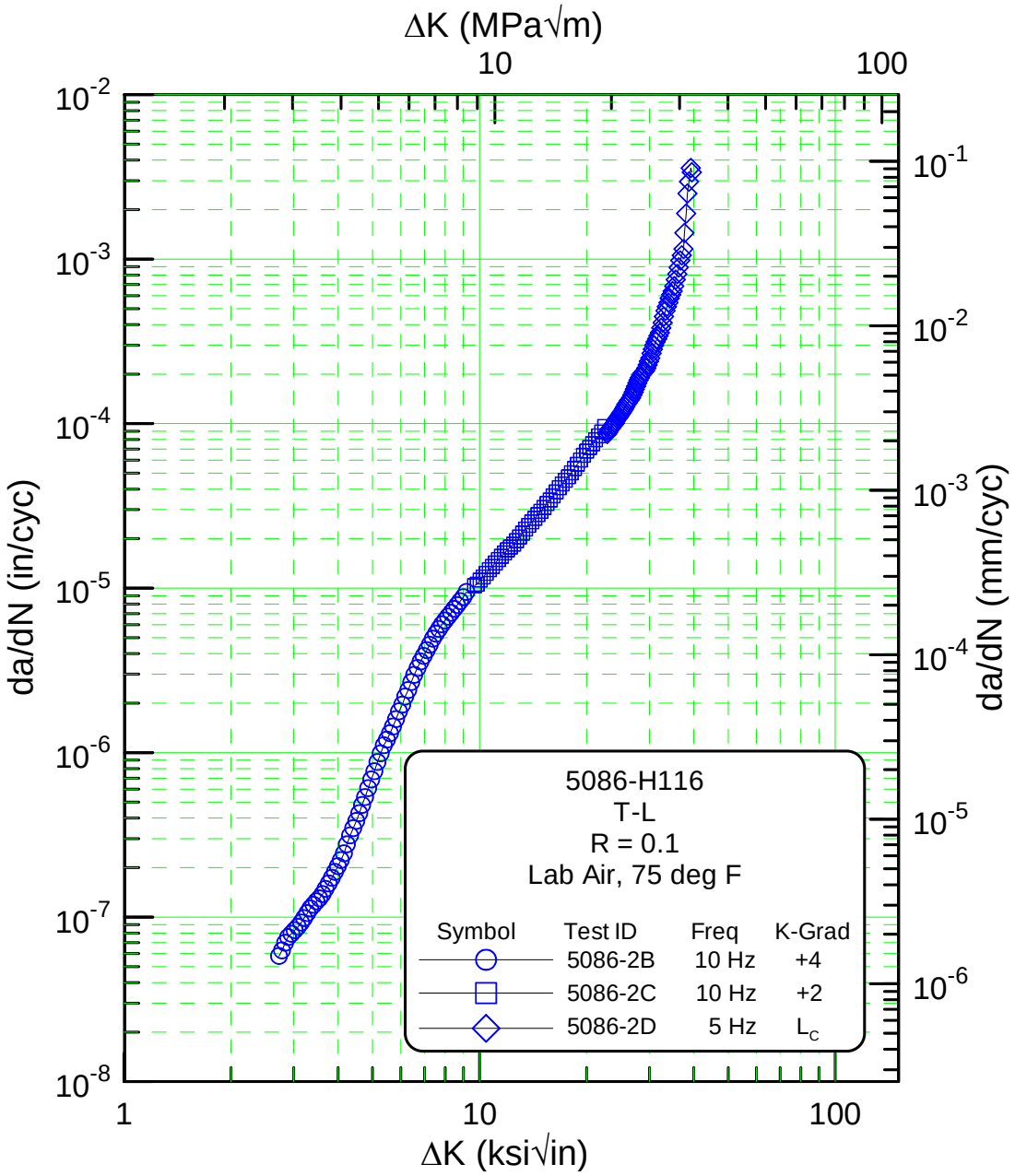


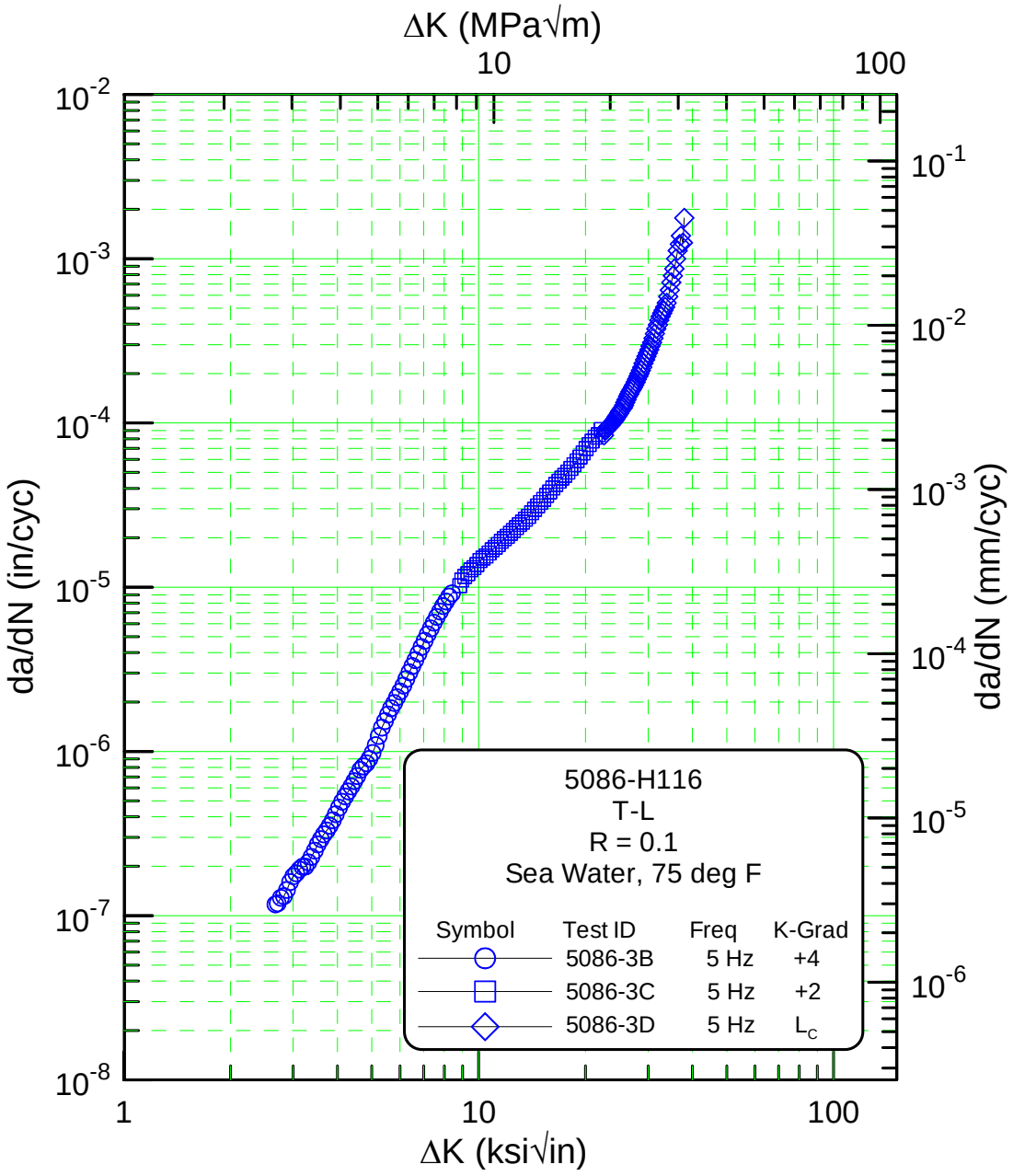
Fatigue Crack Growth Rate vs. Stress Intensity



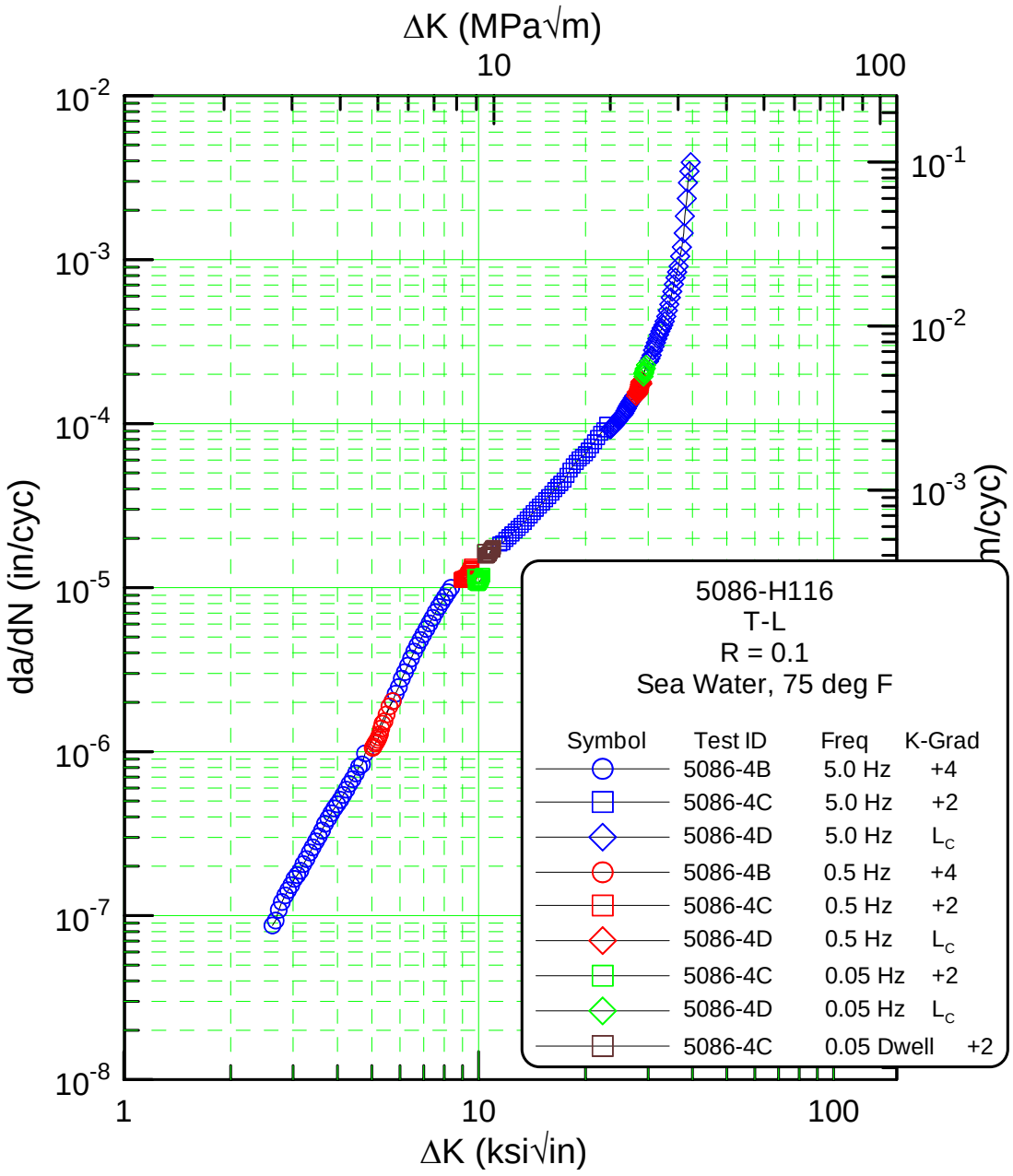
Fatigue Crack Growth Rate vs. Stress Intensity



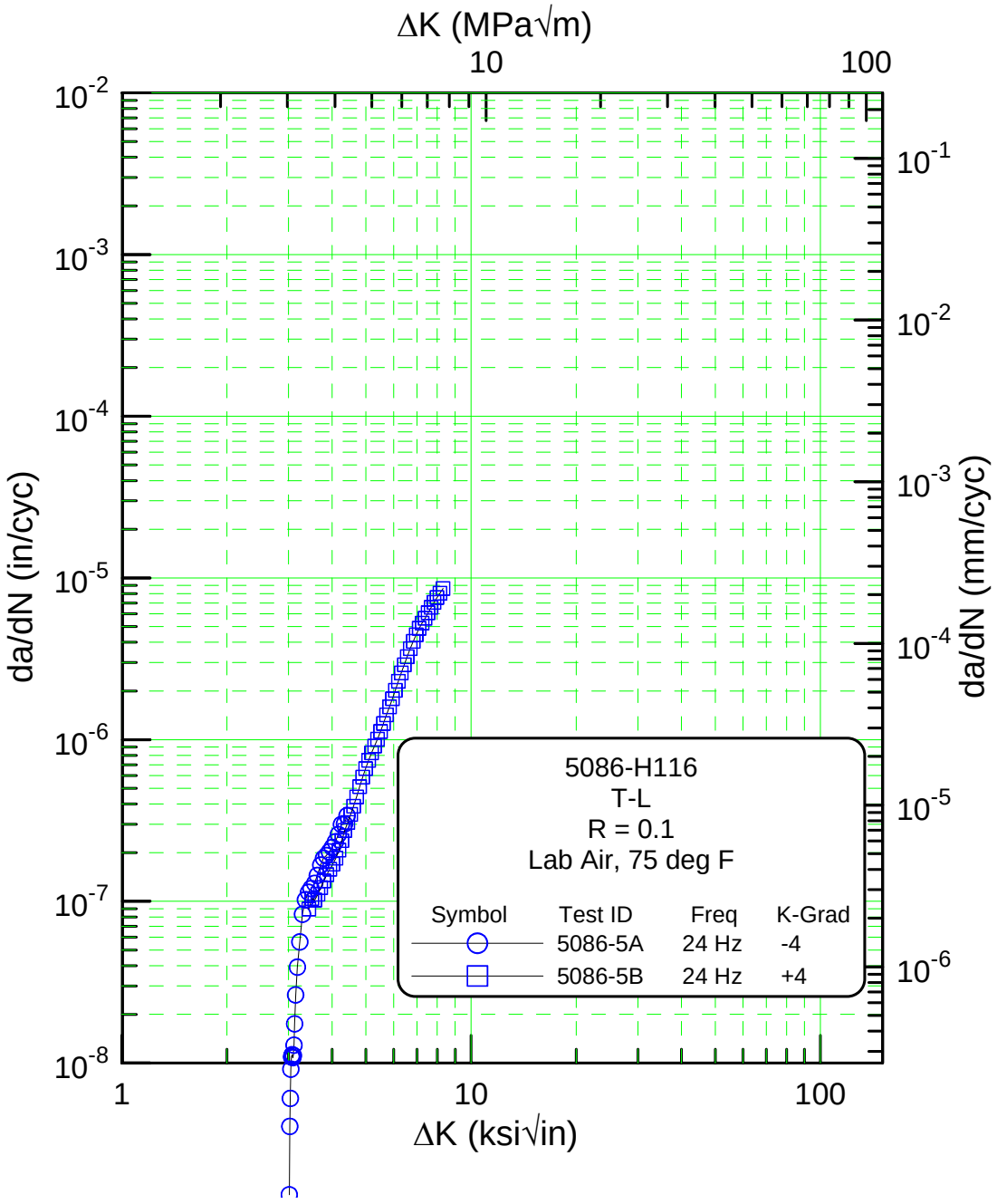
Fatigue Crack Growth Rate vs. Stress Intensity



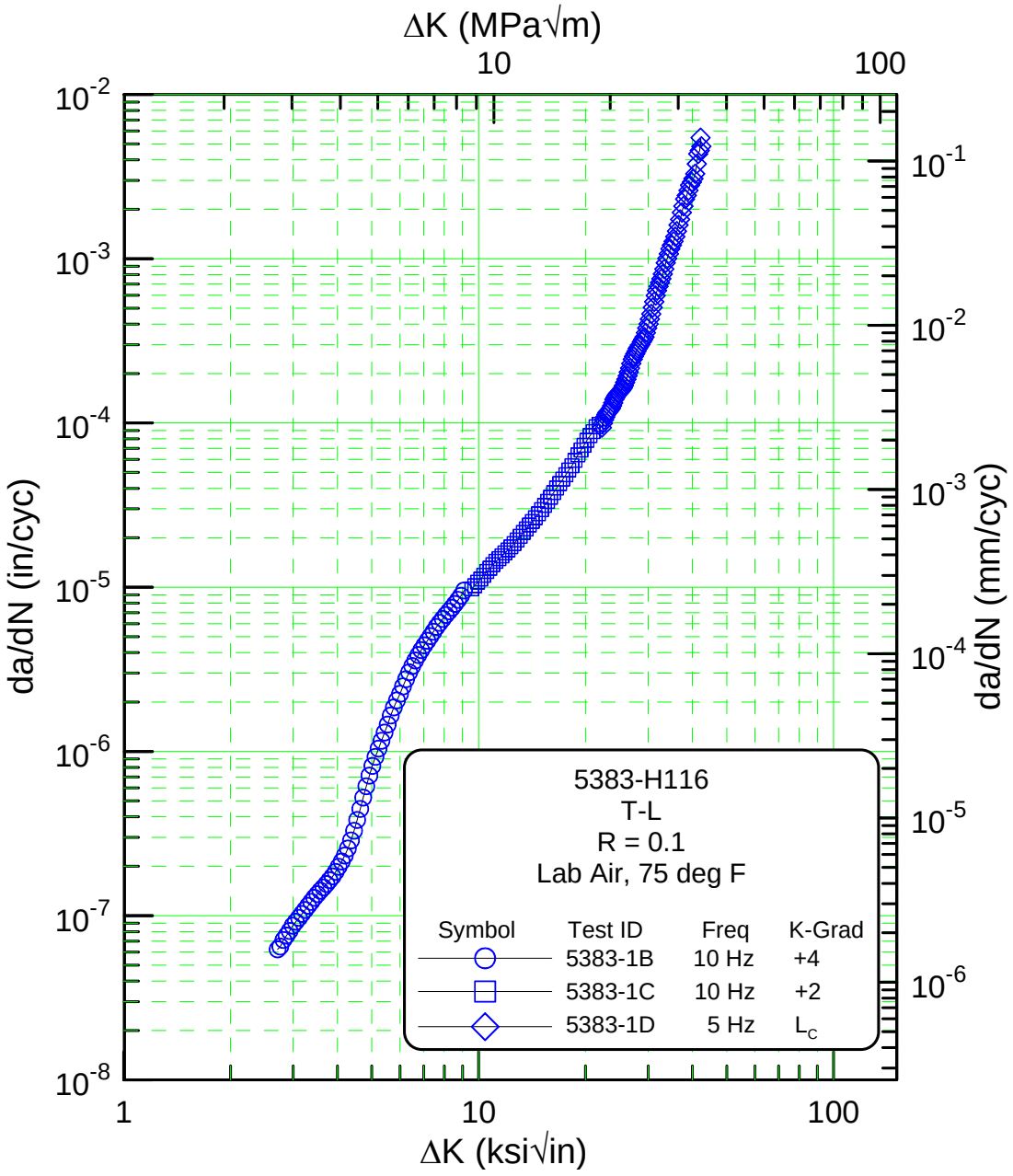
Fatigue Crack Growth Rate vs. Stress Intensity



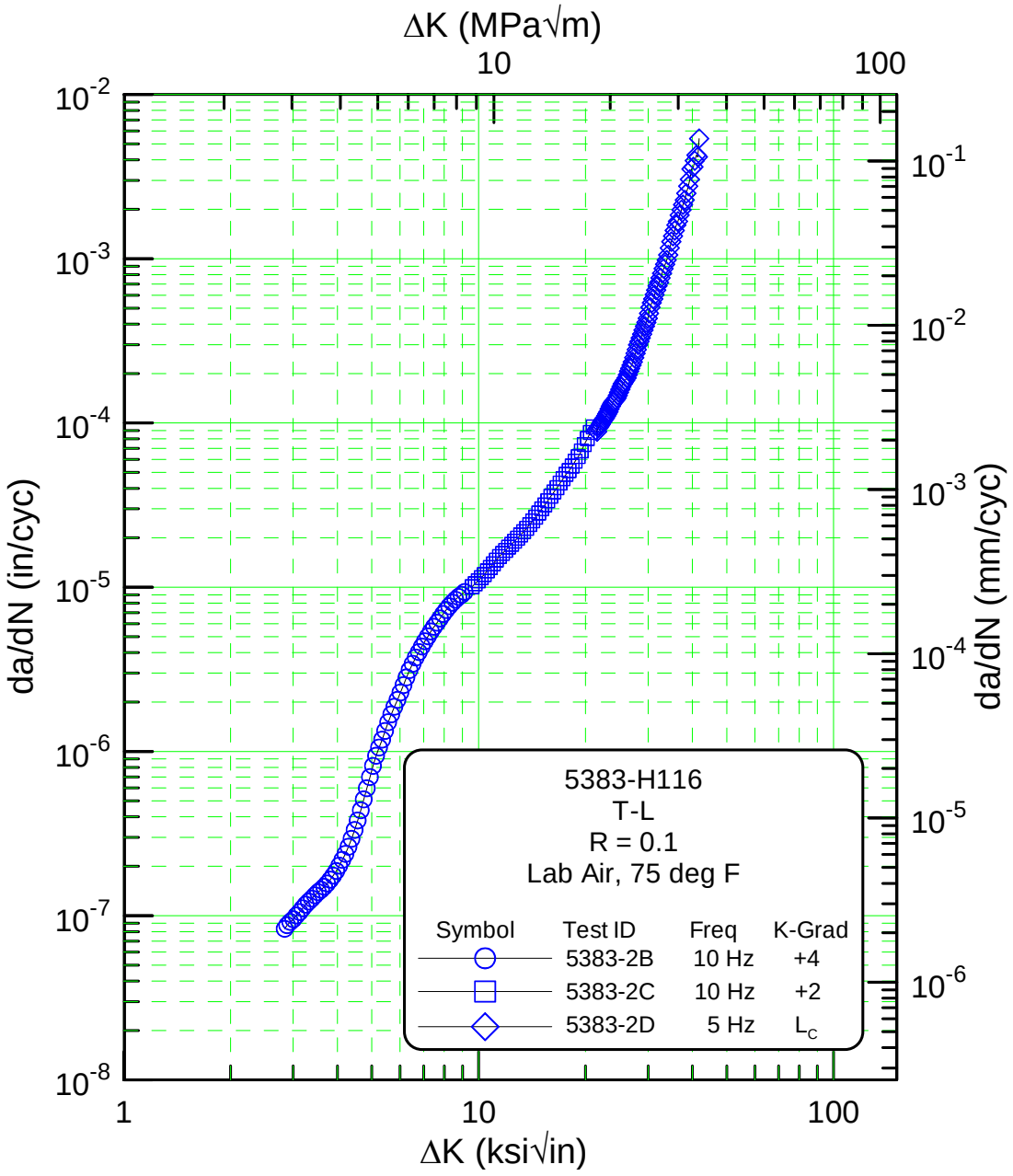
Fatigue Crack Growth Rate vs. Stress Intensity



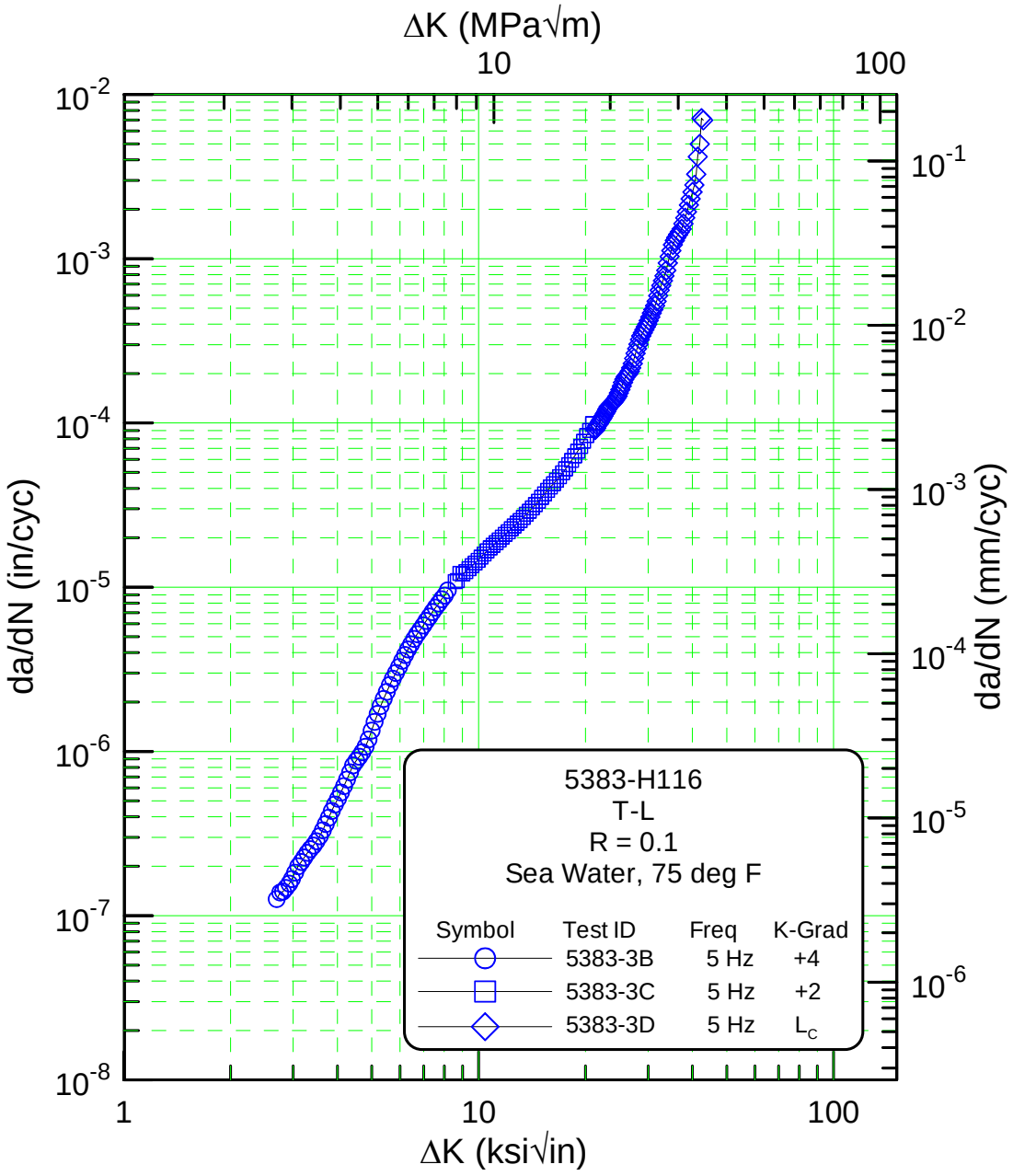
Fatigue Crack Growth Rate vs. Stress Intensity



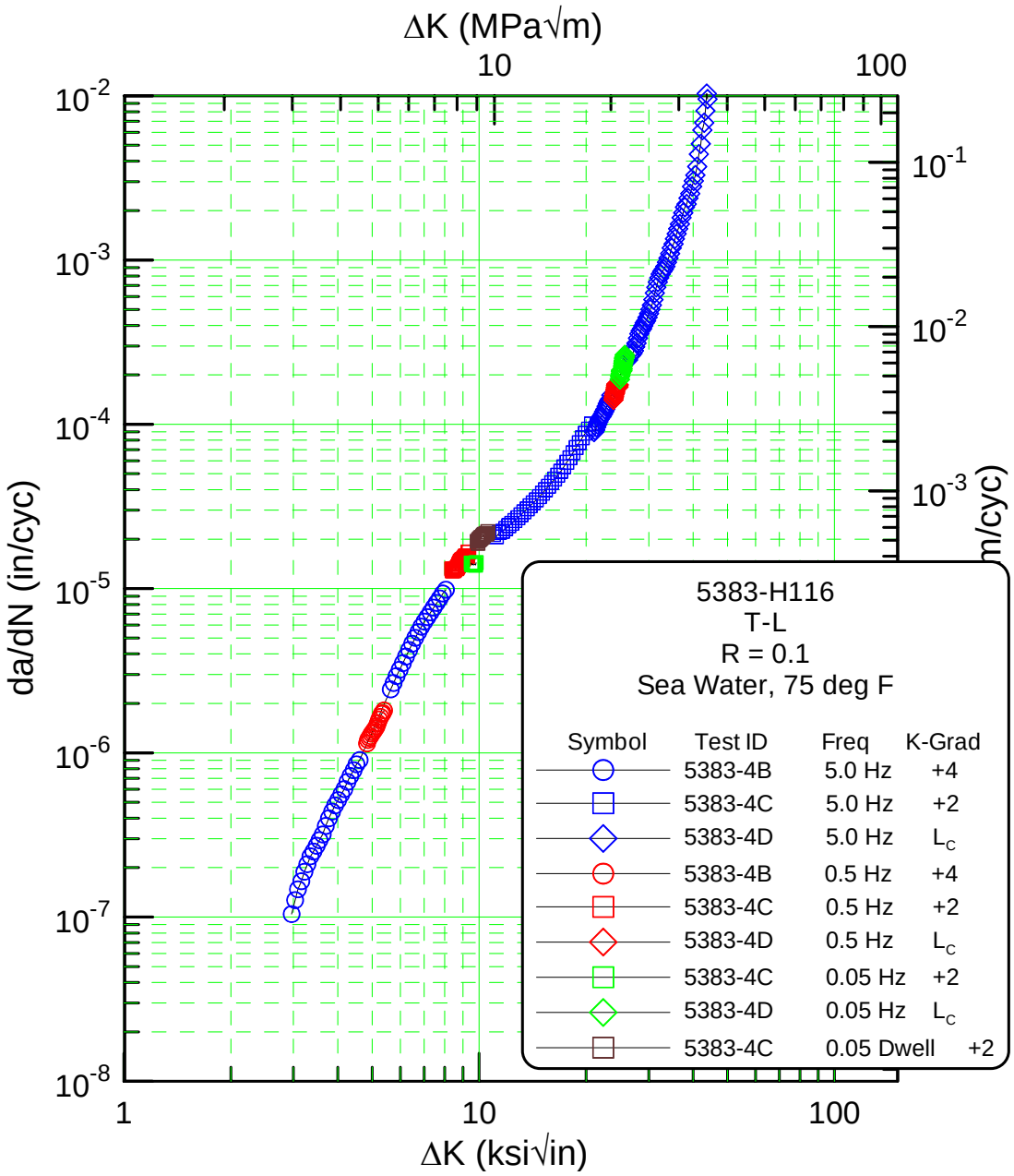
Fatigue Crack Growth Rate vs. Stress Intensity



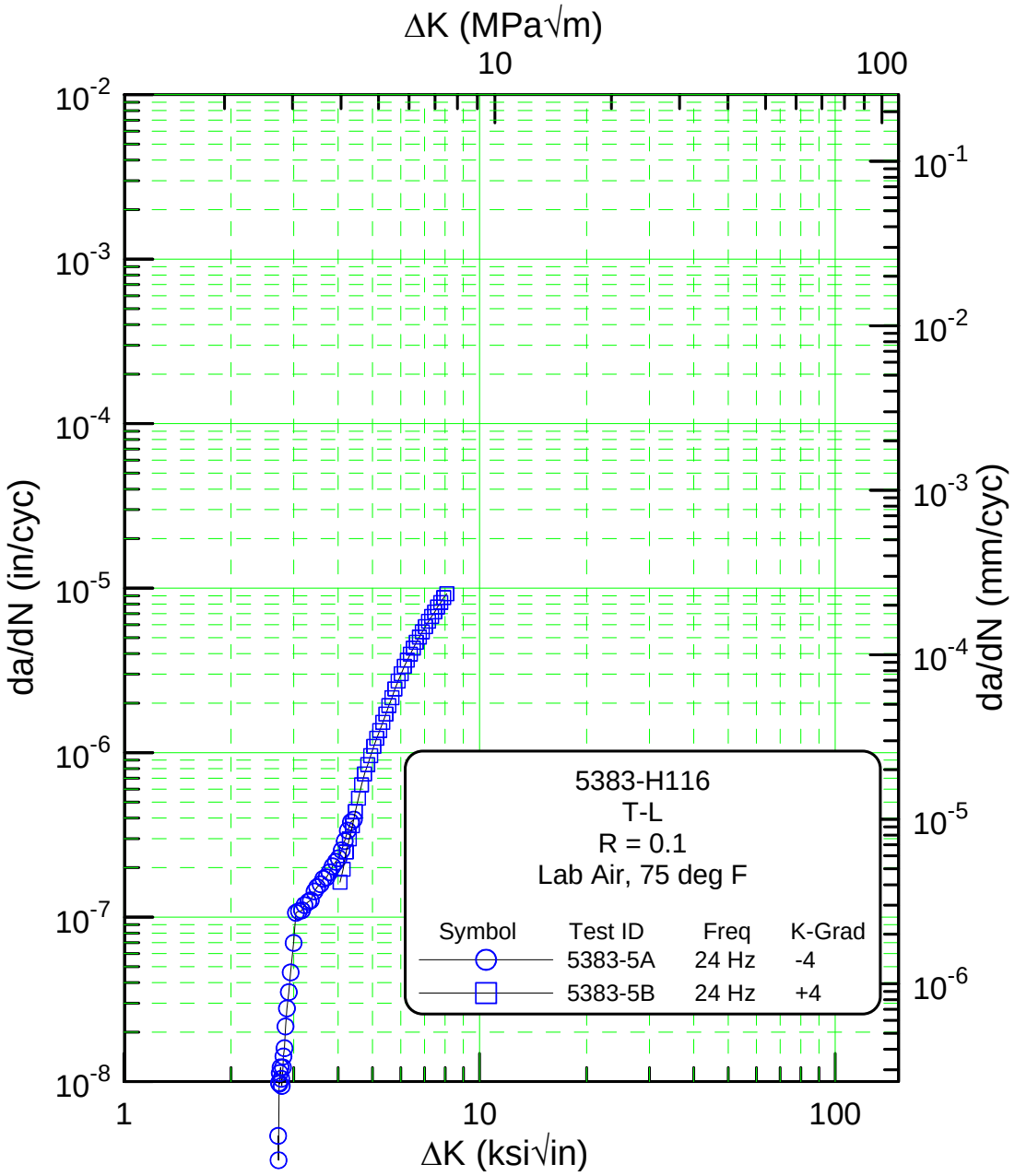
Fatigue Crack Growth Rate vs. Stress Intensity

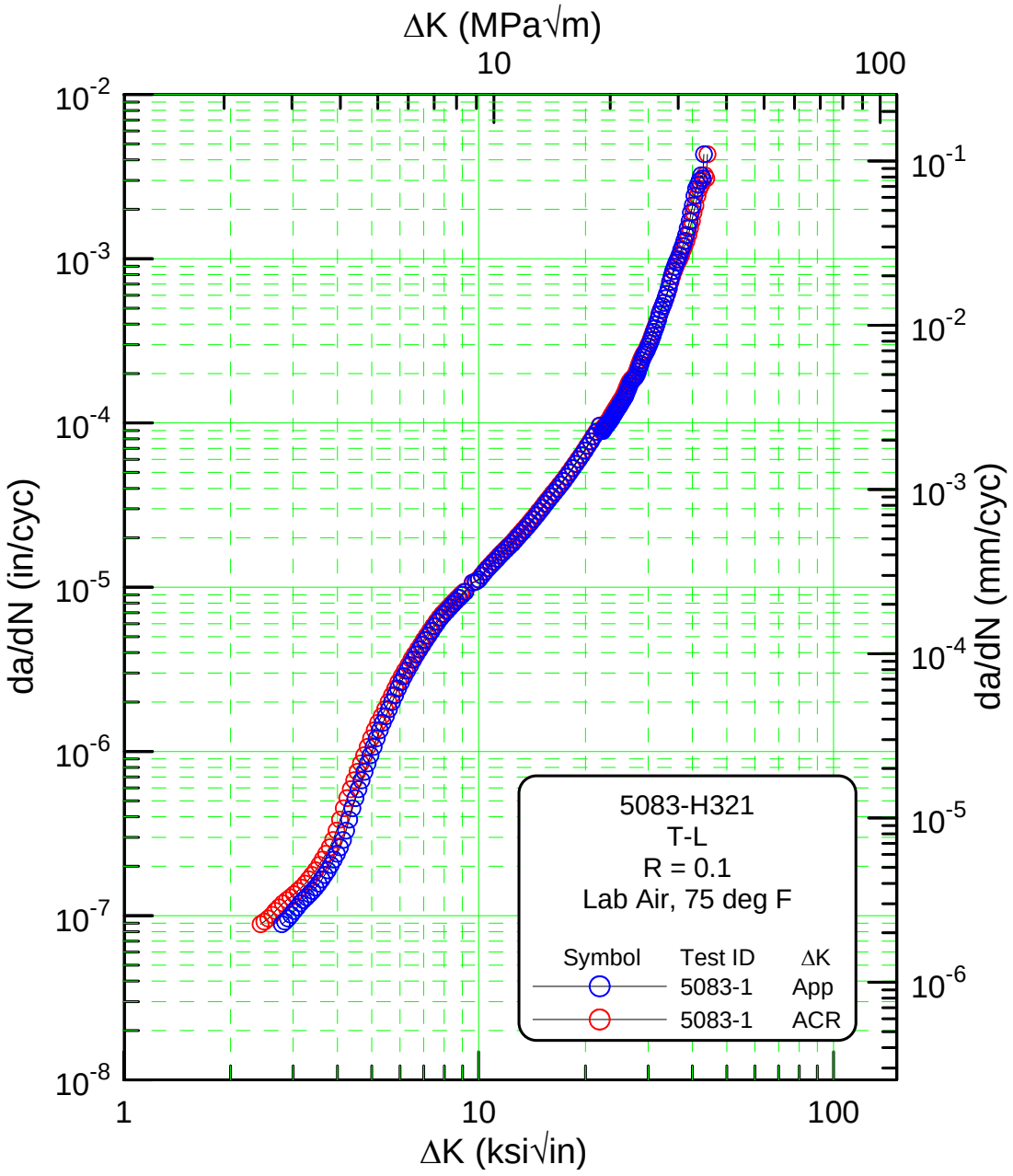


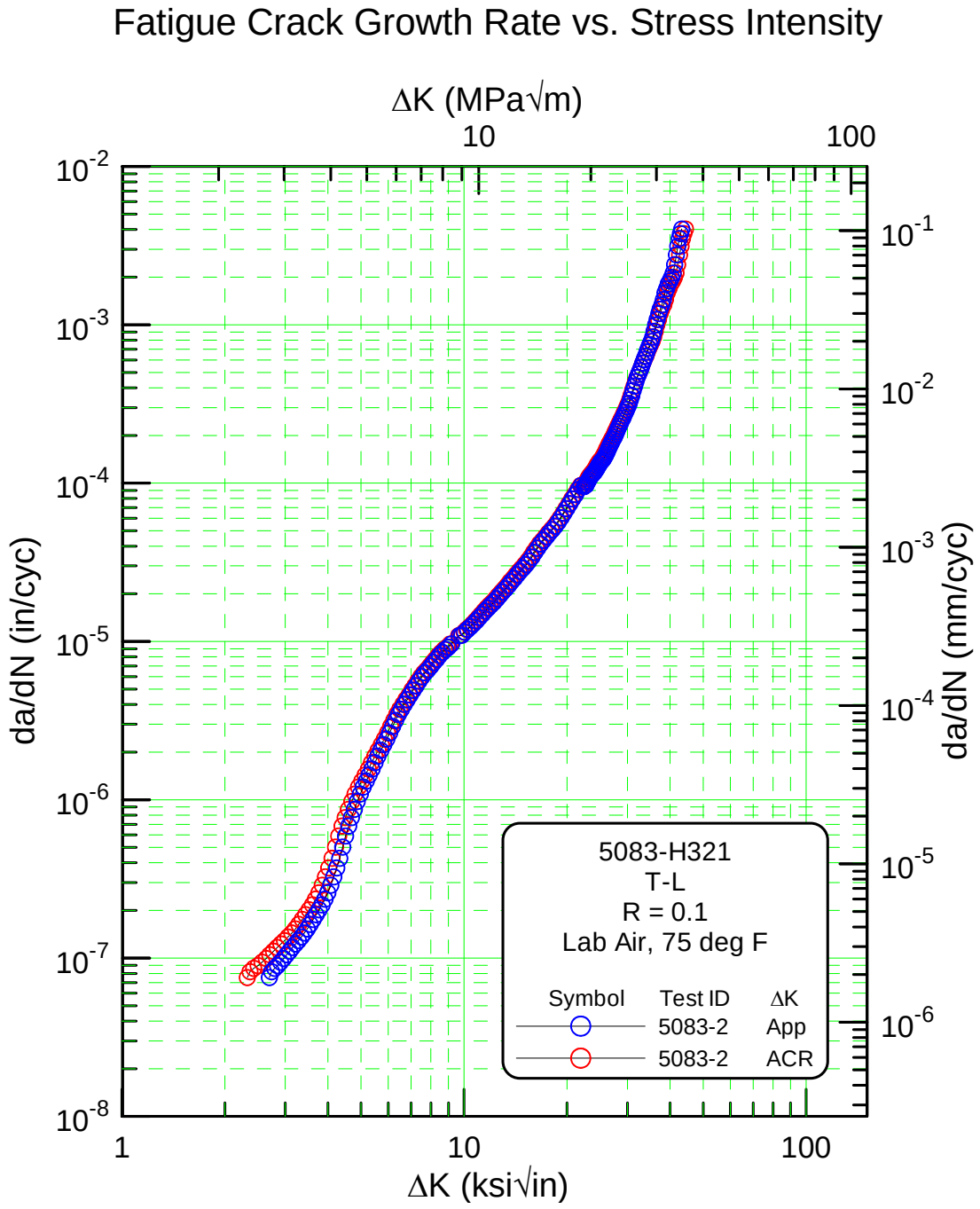
Fatigue Crack Growth Rate vs. Stress Intensity

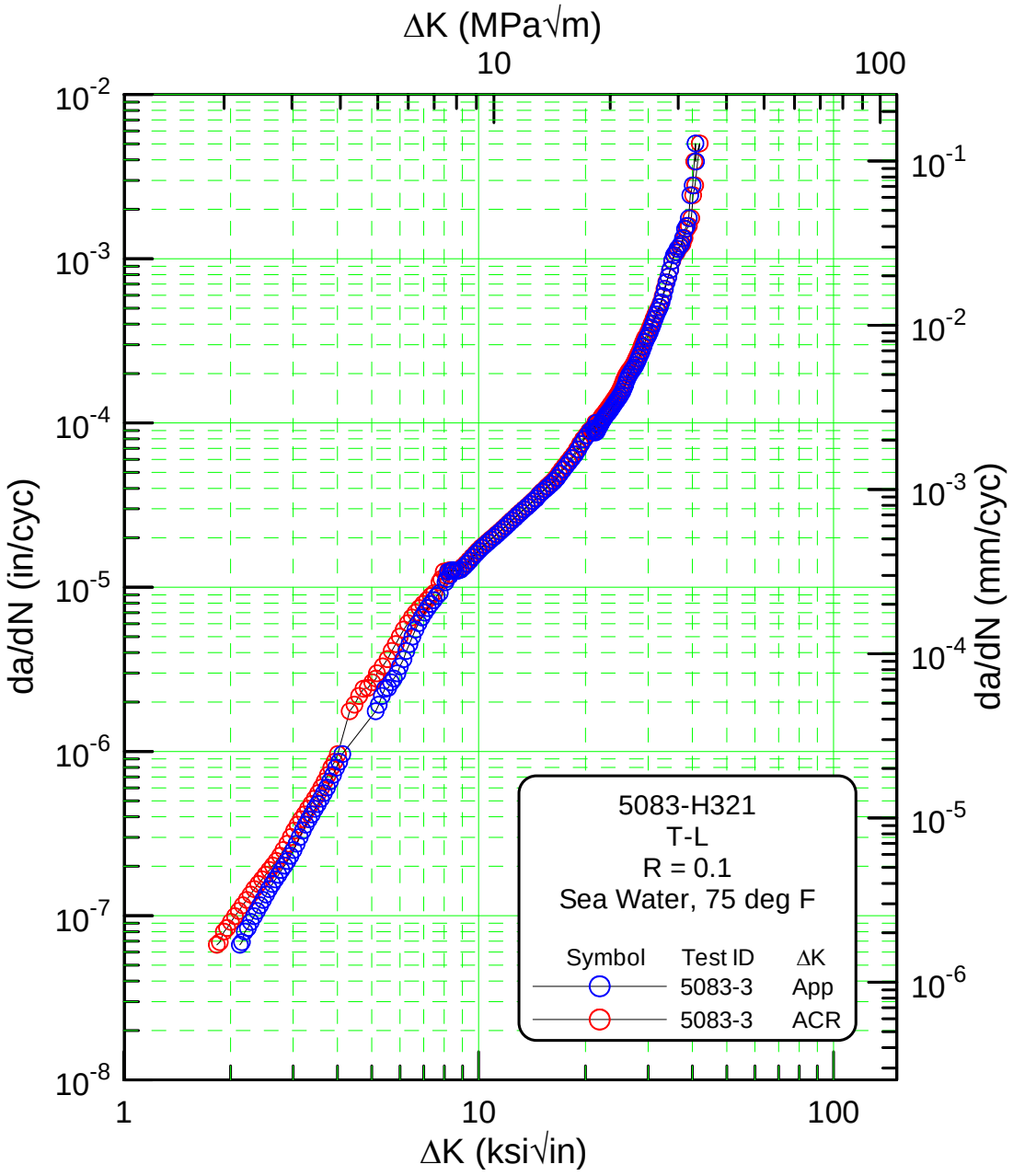


Fatigue Crack Growth Rate vs. Stress Intensity




Fatigue Crack Growth Rate vs. Stress Intensity
ΔK (MPa√m)
10
100
10-2
10-3
10-4
10-5
10-6
10-7
10-8
10-1
10-2
10-3
10-4
10-5
10-6
da/dN (in/cyc)
da/dN (mm/cyc)
1
10
100
ΔK (ksi√in)
5083-H321
T-L
R = 0.1
Lab Air, 75 deg F
Symbol
Test ID
ΔK
5083-1
App
5083-1
ACR


Fatigue Crack Growth Rate vs. Stress Intensity
ΔK (MPa√m)
10
100
10-2
10-3
10-4
10-5
10-6
10-7
10-8
10-1
10-2
10-3
10-4
10-5
10-6
da/dN (in/cyc)
da/dN (mm/cyc)
1
10
100
ΔK (ksi√in)
5083-H321
T-L
R = 0.1
Lab Air, 75 deg F
Symbol
Test ID
ΔK
5083-2
App
5083-2
ACR


Fatigue Crack Growth Rate vs. Stress Intensity
ΔK (MPa√m)
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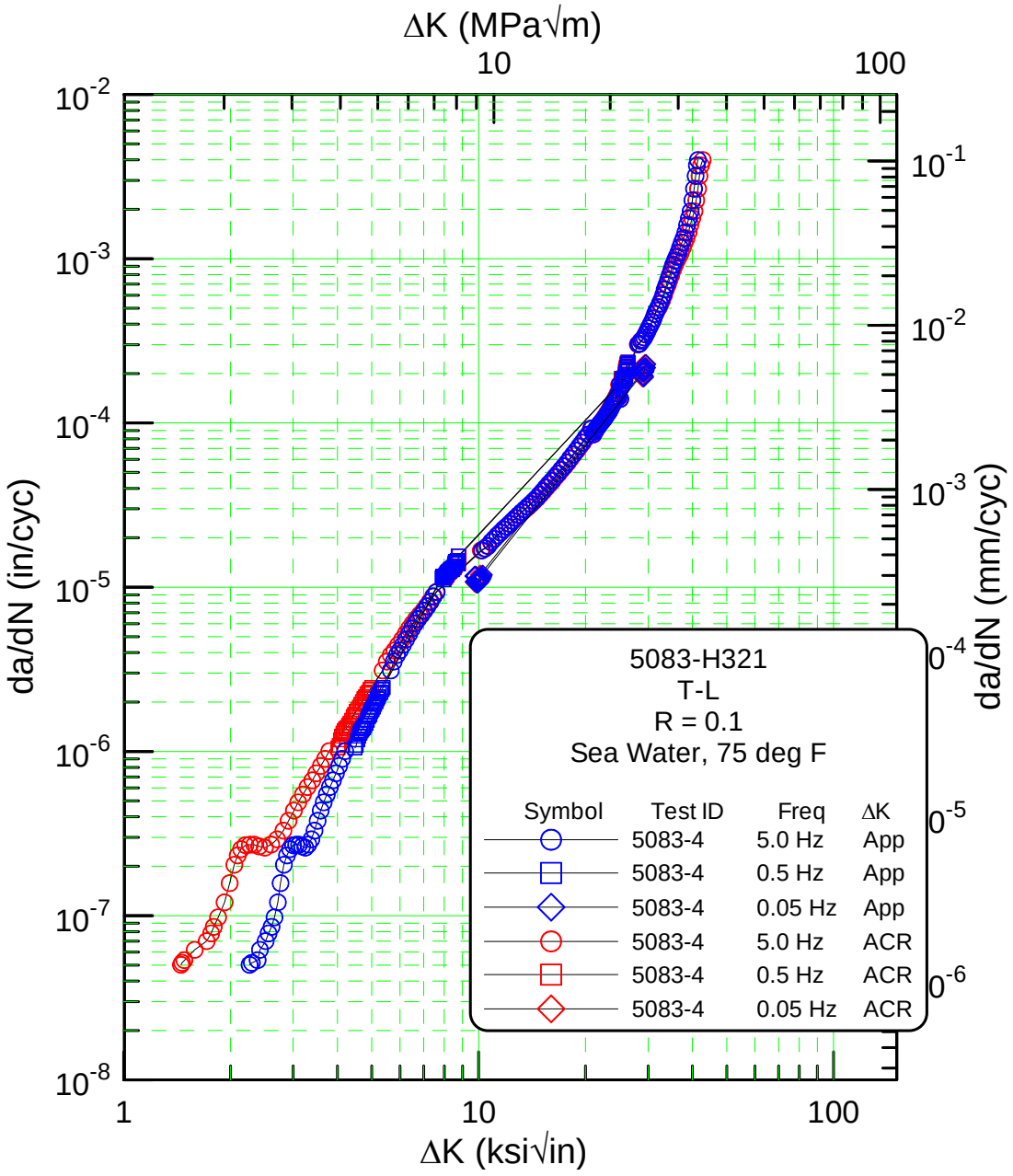
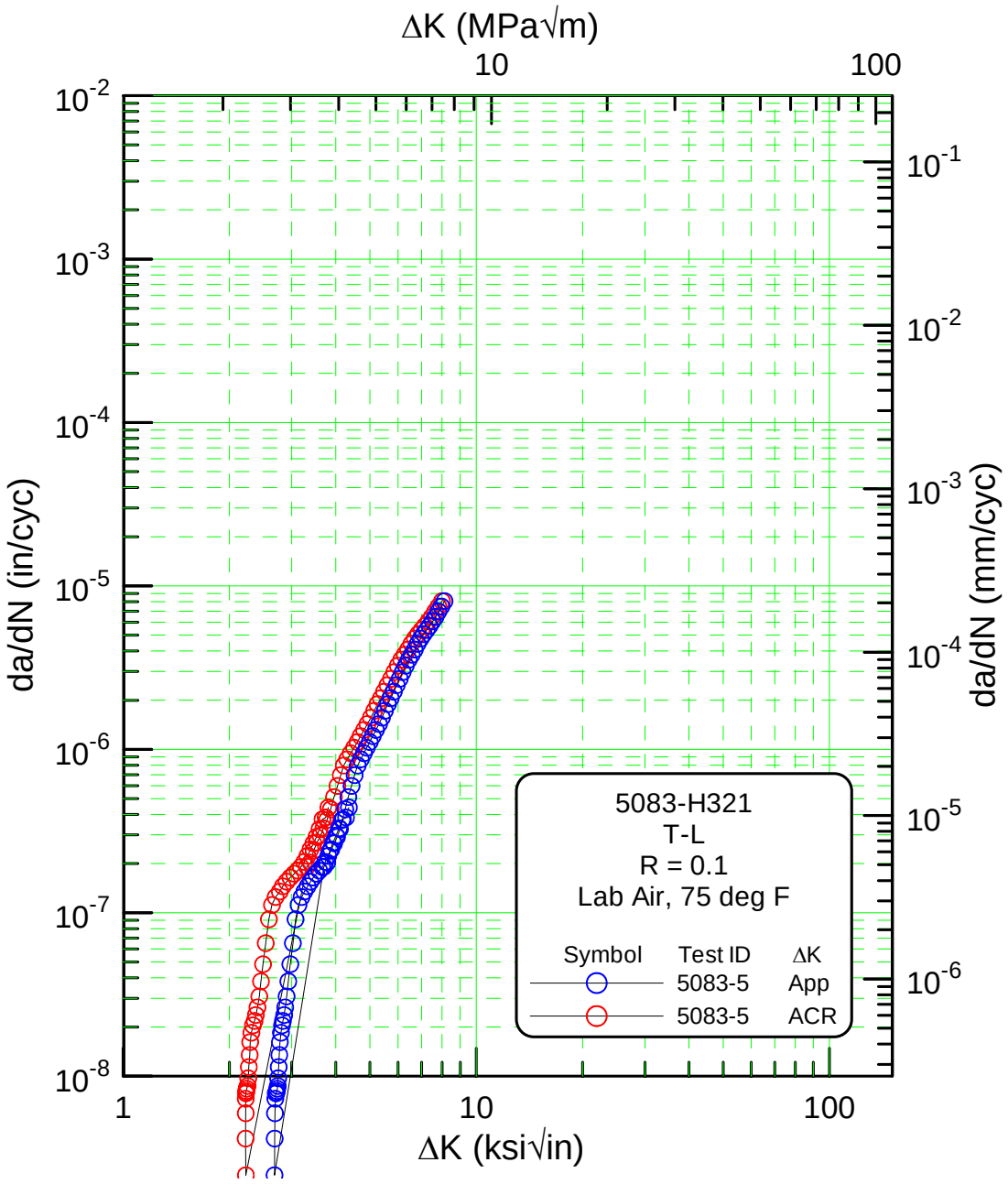
100
10-2
10-3
10-4
10-5
10-6
10-7
10-8
10-1
10-2
10-3
10-4
10-5
10-6
da/dN (in/cyc)
da/dN (mm/cyc)
1
10
100
ΔK (ksi√in)
5083-H321
T-L
R = 0.1
Sea Water, 75 deg F
Symbol
Test ID
ΔK
5083-3
App
5083-3
ACR

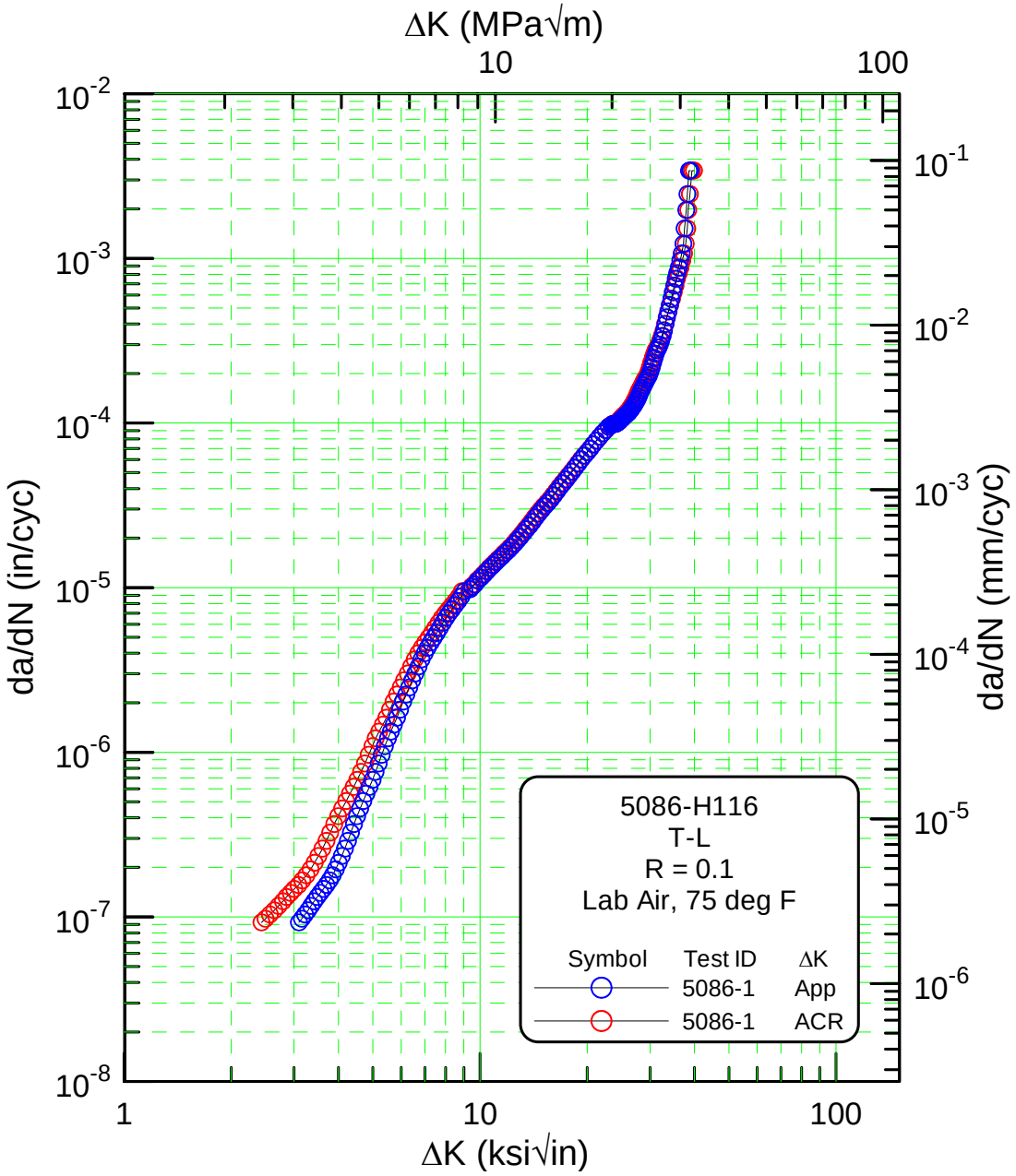
Fatigue Crack Growth Rate vs. Stress Intensity



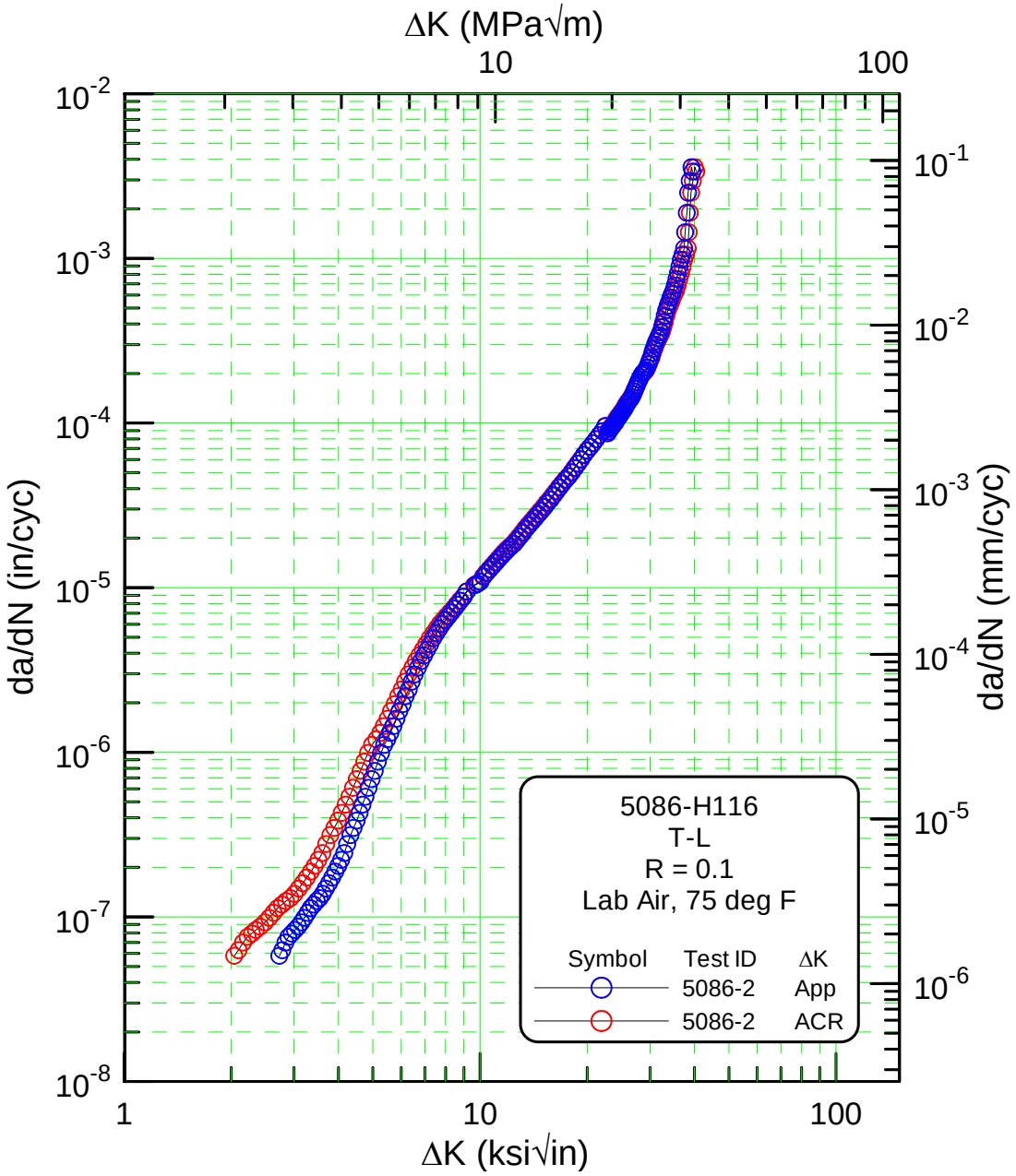
Fatigue Crack Growth Rate vs. Stress Intensity



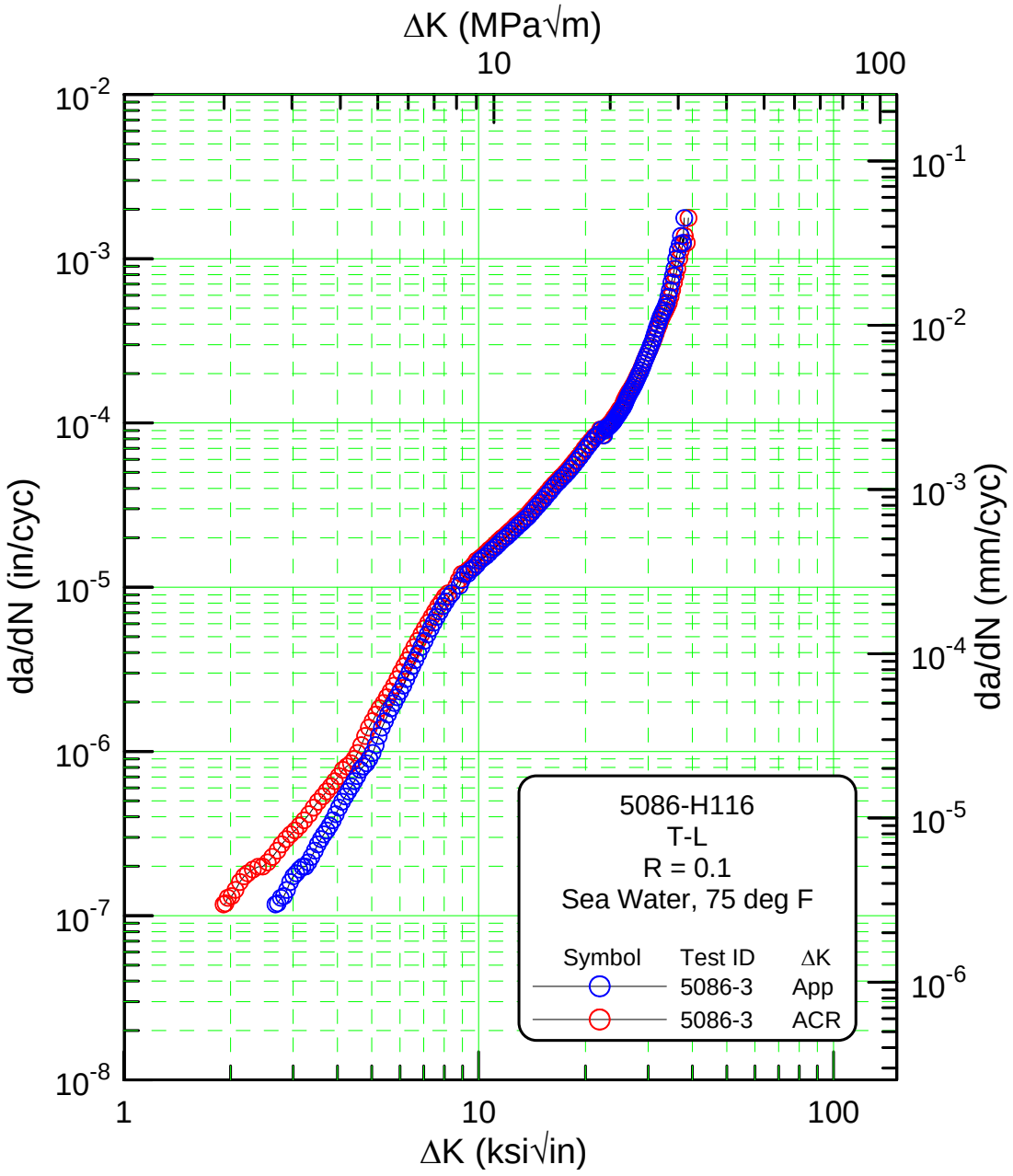
Fatigue Crack Growth Rate vs. Stress Intensity



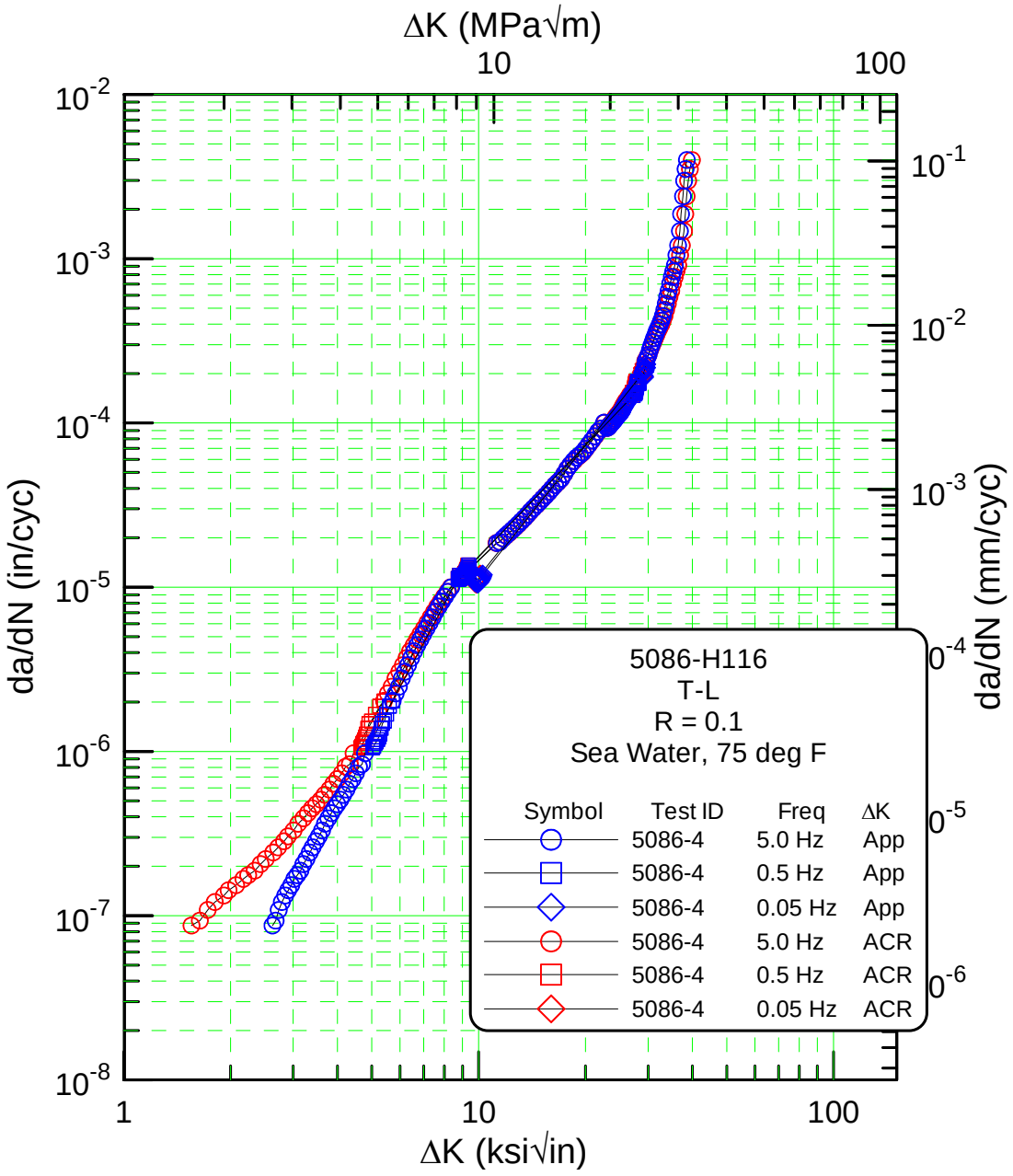
Fatigue Crack Growth Rate vs. Stress Intensity



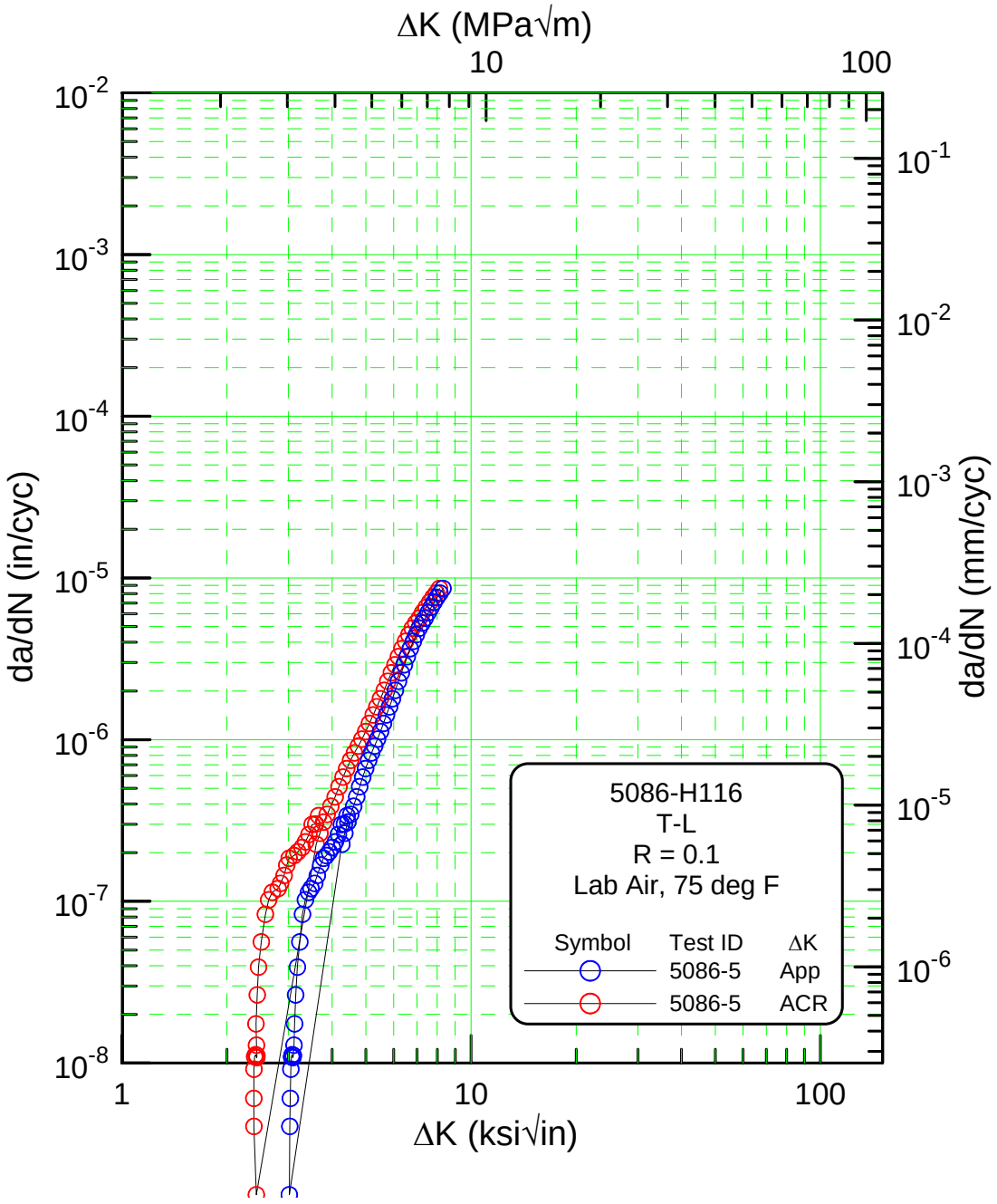
Fatigue Crack Growth Rate vs. Stress Intensity



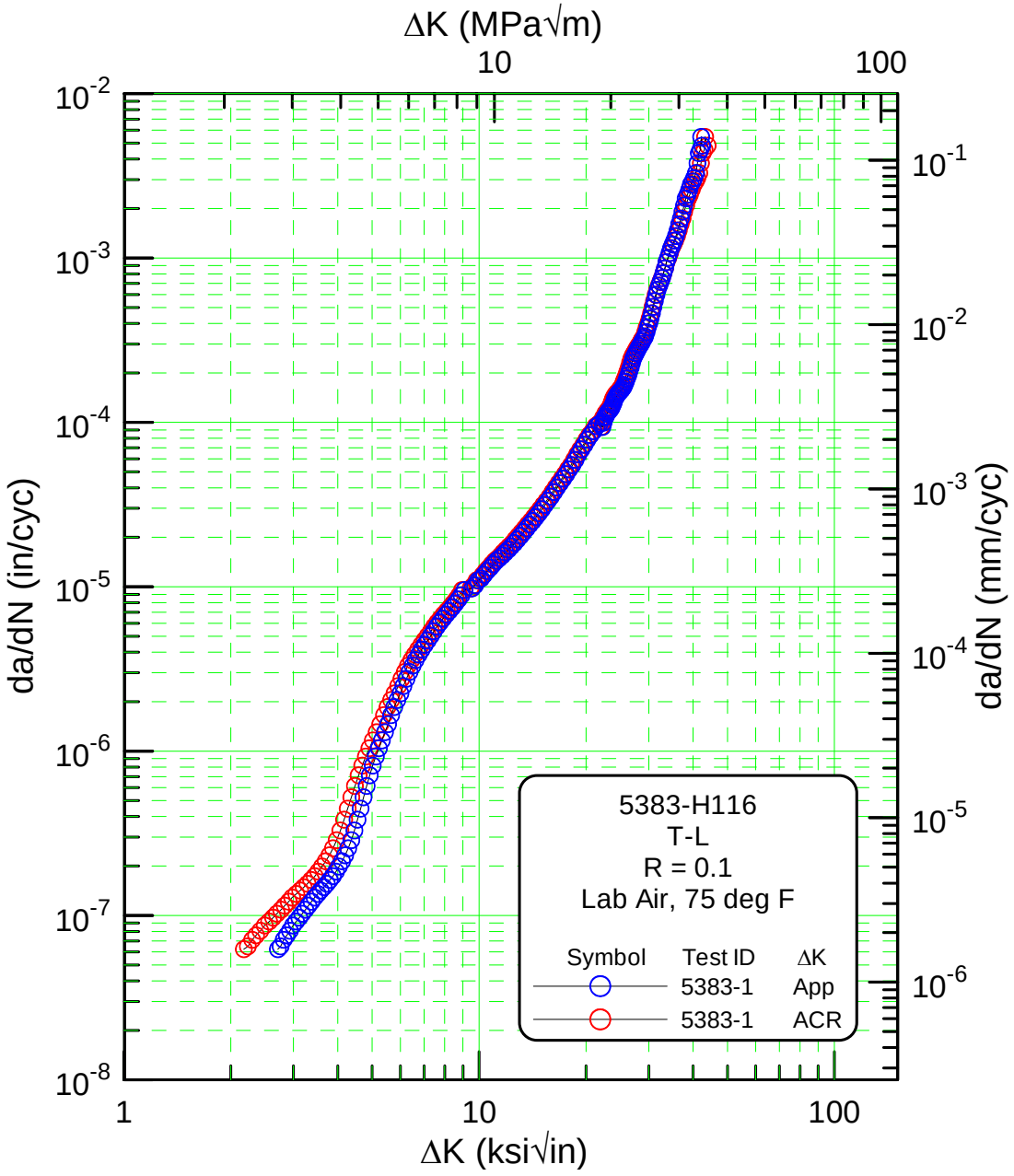
Fatigue Crack Growth Rate vs. Stress Intensity



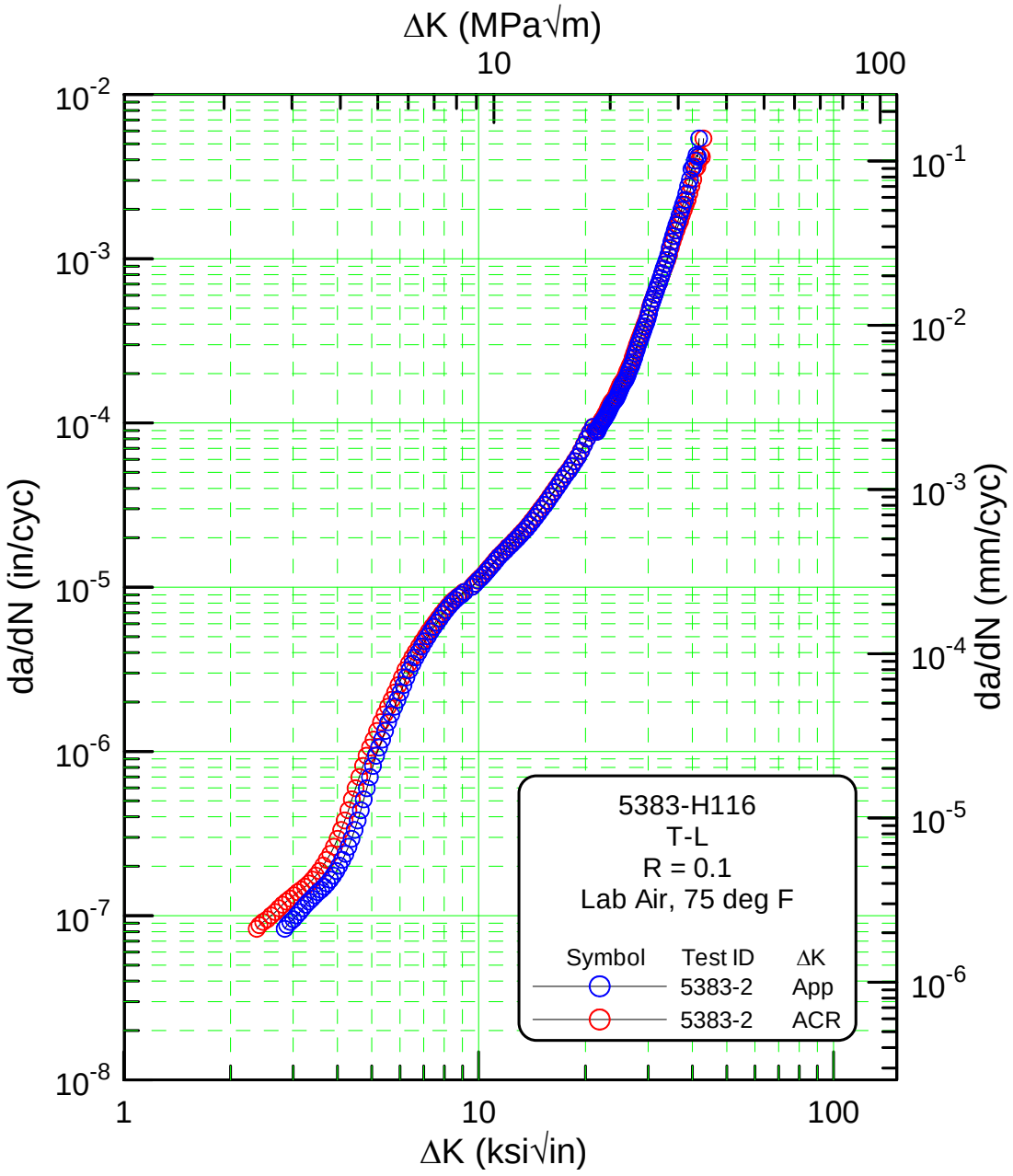
Fatigue Crack Growth Rate vs. Stress Intensity



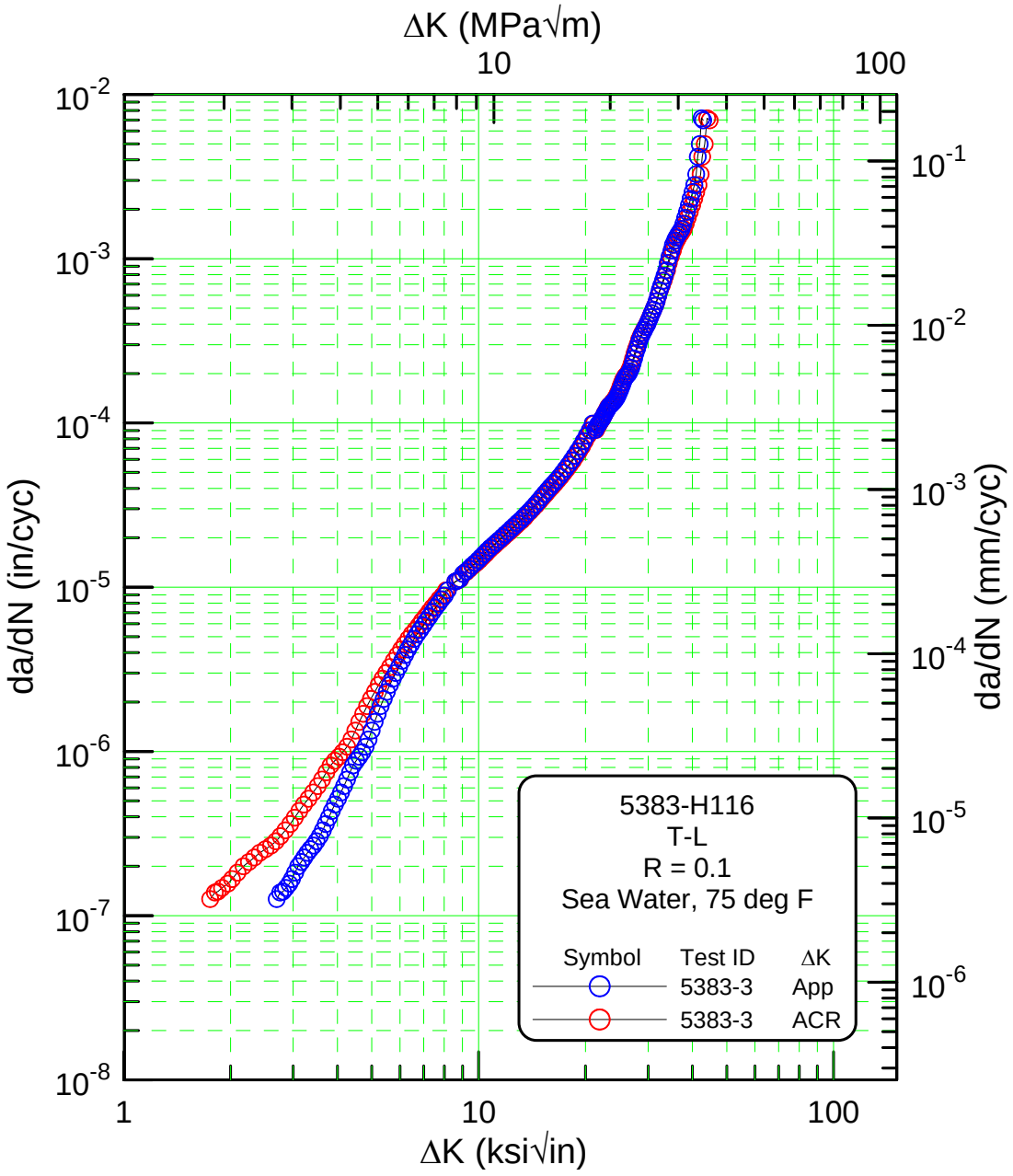
Fatigue Crack Growth Rate vs. Stress Intensity



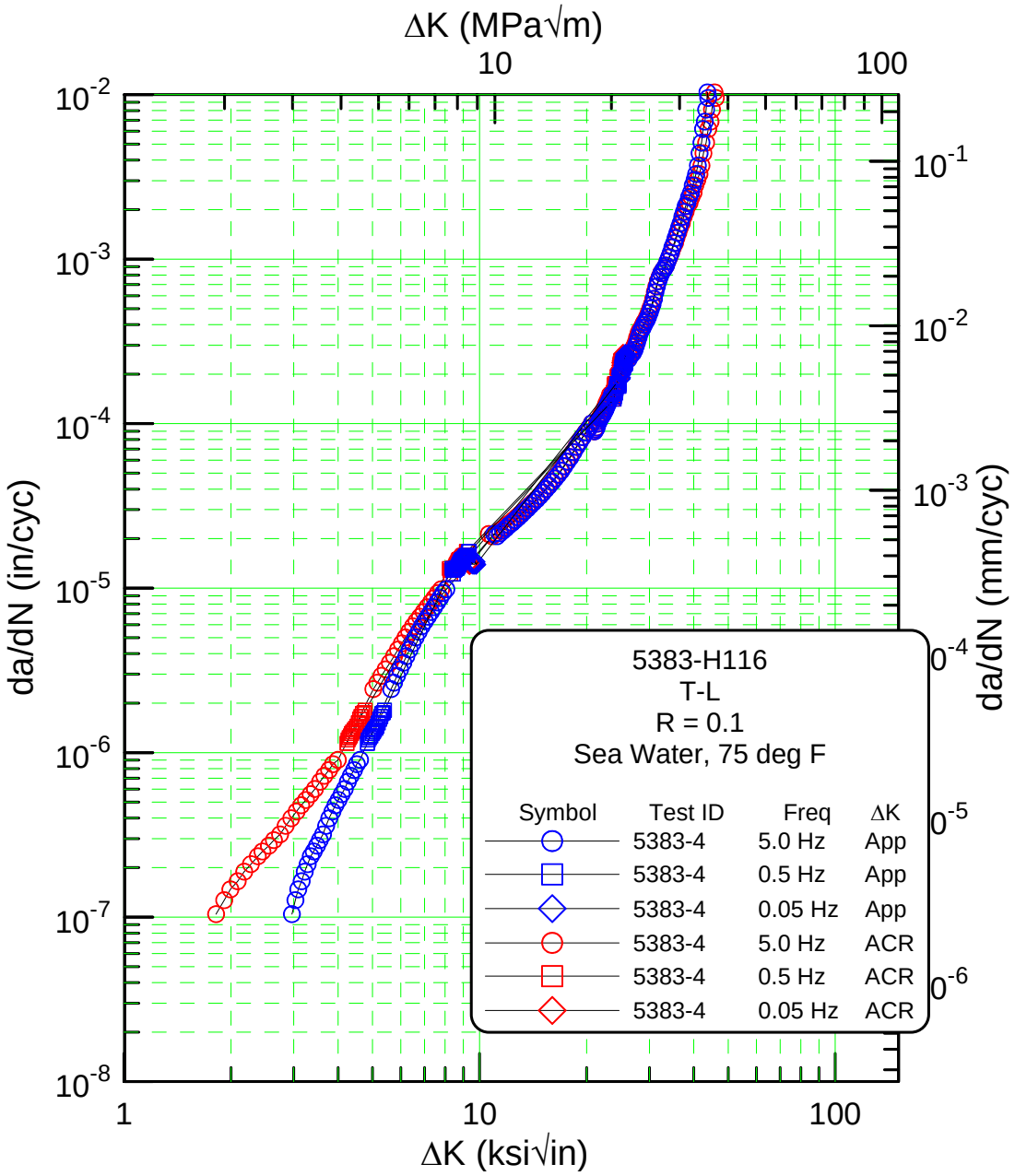
Fatigue Crack Growth Rate vs. Stress Intensity



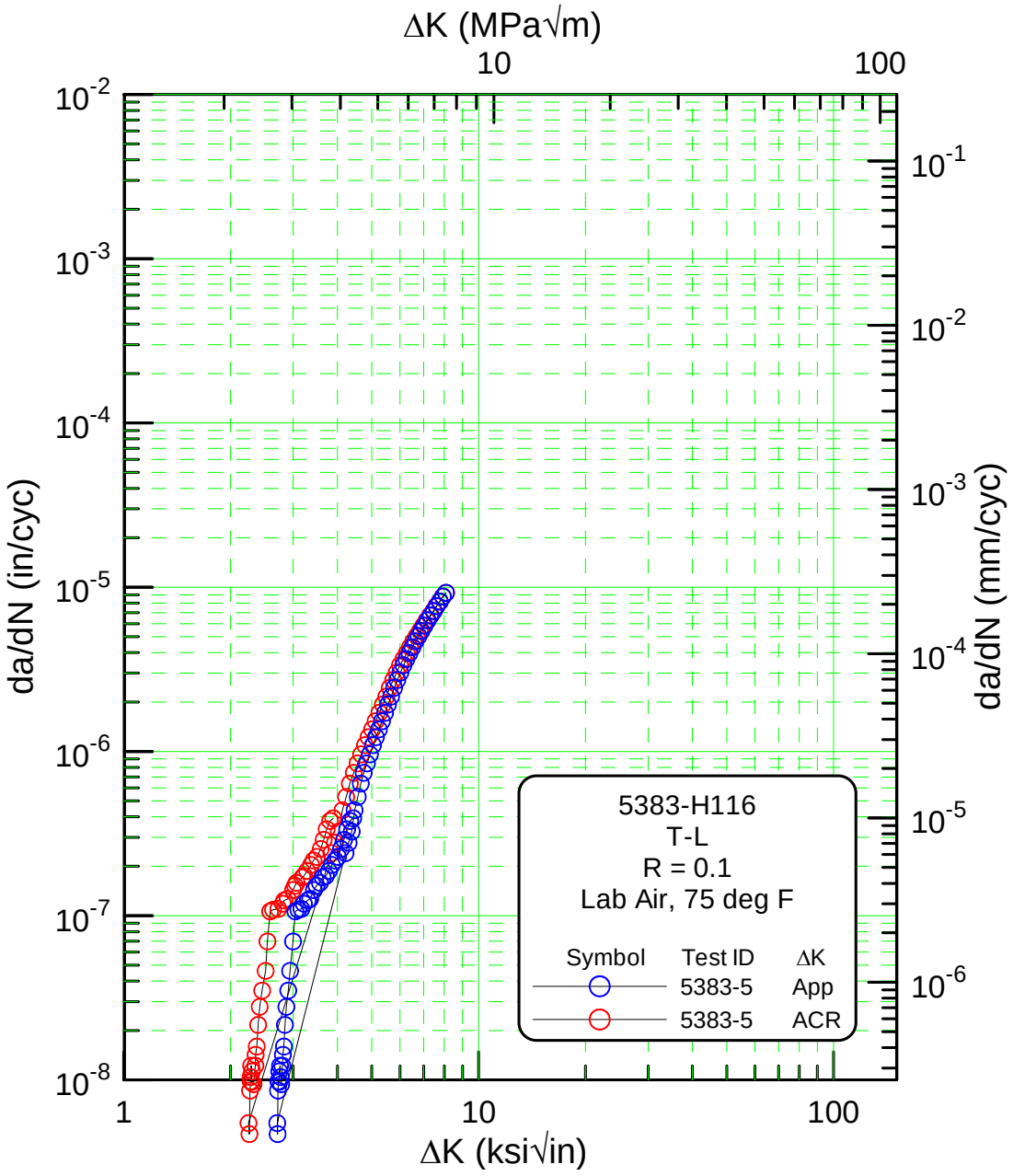
Fatigue Crack Growth Rate vs. Stress Intensity



Fatigue Crack Growth Rate vs. Stress Intensity



Fatigue Crack Growth Rate vs. Stress Intensity



Annex E – Tabular Results – ASTM E647 Analysis

Automated Fatigue Crack
Growth Rate Analysis

Test ID	5083-FCG-1	Geometry	C(T)
Contract	SSC 10624-01	Orientation	T-L
Material	5083-H321	Yield (ksi)	34.3
Temperature (F)	75	Modulus (Msi)	10.5
Environment	RH = 40%		

Specimen Dimensions (in)

Thickness	0.499	Height	2.400
Net Thickness	0.499	Notch Depth	1.000
Width	4.000	Gage Length	0.500

Precrack Parameters

Pmax (lbs)	784.0	Stress Ratio	0.10
Final a (in)	1.050	Kmax (ksi sqr[in])	4.00

Test Parameters

EvBP	Freq	Pmax	R	Ai	Kmaxi	C	DKi
23.681	10.00	0	0.10	1.140	3.00	4.00	0.00
31.519	10.00	0	0.10	1.456	10.59	2.00	0.00
49.471	5.00	2800	0.10	0.000	0.00	0.00	0.00

K Coeff	C Coeff
.886	1.00098
4.64	-4.66951
-13.32	18.4601
14.72	-236.825
-5.6	1214.88
.	-2143.57

Visual Observations

EvB/P	Crack(EvB/P)	Crack(visual)	Error	CAF
20.683	1.001	1.002	0.001	1.012
21.433	1.040	1.045	0.005	1.010
21.845	1.060	1.055	-0.005	1.009
23.564	1.142	1.150	0.008	1.004
24.665	1.190	1.195	0.005	1.002
26.544	1.267	1.270	0.003	0.998
27.285	1.296	1.295	-0.001	0.996
31.505	1.443	1.430	-0.013	0.988
44.255	1.773	1.765	-0.008	0.972
49.170	1.869	1.865	-0.004	0.967
89.244	2.357	2.365	0.008	0.944

Comments

Date of test: 8/10/2006
Waveform Type Sine

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Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
	23.68	1.1470	52239					
568	23.79	1.1518	106926	0.0095	106637	8.875E-8	3.099	2.789
577	23.89	1.1564	158876	0.0095	102998	9.213E-8	3.162	2.846
587	24.00	1.1612	209924	0.0047	48855	9.610E-8	3.225	2.902
597	24.11	1.1659	258943	0.0047	46770	1.012E-7	3.289	2.960
607	24.21	1.1706	304075	0.0048	45029	1.068E-7	3.354	3.019
617	24.32	1.1753	345371	0.0048	42580	1.125E-7	3.422	3.080
628	24.43	1.1802	387545	0.0048	40217	1.188E-7	3.492	3.142
639	24.55	1.1852	429050	0.0048	38501	1.243E-7	3.562	3.206
650	24.66	1.1899	465404	0.0048	37173	1.293E-7	3.635	3.271
660	24.77	1.1946	500243	0.0048	35193	1.352E-7	3.707	3.336
672	24.88	1.1993	535082	0.0047	33173	1.415E-7	3.781	3.403
683	24.99	1.2041	568406	0.0047	31760	1.483E-7	3.857	3.471
694	25.10	1.2088	598700	0.0047	30195	1.566E-7	3.934	3.541
706	25.21	1.2135	628088	0.0047	28428	1.664E-7	4.012	3.611
718	25.33	1.2182	655961	0.0047	26631	1.770E-7	4.093	3.683
730	25.44	1.2229	681411	0.0047	25137	1.888E-7	4.174	3.757
743	25.56	1.2277	705649	0.0047	23309	2.036E-7	4.258	3.832
755	25.67	1.2323	728190	0.0047	21539	2.199E-7	4.343	3.909
768	25.79	1.2371	749519	0.0047	20011	2.384E-7	4.429	3.986
781	25.90	1.2418	767940	0.0047	18427	2.606E-7	4.518	4.066
794	26.02	1.2464	785195	0.0048	16764	2.893E-7	4.606	4.146
807	26.13	1.2511	801479	0.0048	14884	3.298E-7	4.700	4.230
821	26.26	1.2560	816211	0.0048	13221	3.848E-7	4.795	4.316
835	26.38	1.2609	828774	0.0048	11604	4.511E-7	4.895	4.405
850	26.51	1.2658	838825	0.0048	10015	5.199E-7	4.994	4.494
864	26.62	1.2704	847267	0.0047	8565	5.885E-7	5.094	4.584
878	26.74	1.2750	854817	0.0047	7329	6.671E-7	5.195	4.676
894	26.86	1.2797	861569	0.0046	6441	7.515E-7	5.296	4.766
908	26.98	1.2843	867603	0.0047	5780	8.458E-7	5.402	4.862
923	27.10	1.2890	872748	0.0047	5166	9.484E-7	5.508	4.957
939	27.23	1.2937	877473	0.0047	4589	1.065E-6	5.619	5.057
955	27.36	1.2986	881948	0.0047	4066	1.203E-6	5.733	5.160
972	27.48	1.3034	885810	0.0048	3685	1.346E-6	5.848	5.263
988	27.61	1.3081	889103	0.0048	3331	1.491E-6	5.965	5.369
1004	27.73	1.3127	891997	0.0047	2954	1.638E-6	6.085	5.477
1022	27.86	1.3175	894859	0.0047	2658	1.806E-6	6.207	5.586
1039	27.99	1.3224	897460	0.0047	2421	2.000E-6	6.331	5.698
1056	28.12	1.3269	899673	0.0047	2217	2.200E-6	6.458	5.812
1074	28.25	1.3317	901756	0.0047	2004	2.418E-6	6.587	5.928
1093	28.38	1.3365	903631	0.0047	1818	2.641E-6	6.717	6.046
1111	28.51	1.3411	905298	0.0048	1684	2.871E-6	6.852	6.167
1129	28.64	1.3458	906881	0.0048	1549	3.107E-6	6.989	6.290
1149	28.77	1.3506	908369	0.0047	1426	3.347E-6	7.131	6.418

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
1169	28.91	1.3556	909778	0.0047	1326	3.622E-6	7.275	6.548
1189	29.04	1.3603	911052	0.0047	1232	3.896E-6	7.422	6.680
1208	29.17	1.3649	912189	0.0047	1142	4.174E-6	7.570	6.813
1229	29.31	1.3696	913256	0.0047	1064	4.457E-6	7.717	6.945
1249	29.44	1.3742	914270	0.0047	993	4.759E-6	7.871	7.084
1270	29.58	1.3789	915219	0.0047	937	5.068E-6	8.028	7.226
1292	29.72	1.3838	916159	0.0048	886	5.423E-6	8.190	7.371
1314	29.86	1.3886	917012	0.0048	832	5.797E-6	8.357	7.521
1337	30.00	1.3933	917811	0.0048	783	6.166E-6	8.527	7.675
1360	30.14	1.3983	918571	0.0048	733	6.536E-6	8.699	7.829
1383	30.28	1.4030	919262	0.0047	692	6.869E-6	8.874	7.987
1406	30.42	1.4076	919919	0.0047	655	7.203E-6	9.052	8.147
1430	30.56	1.4124	920559	0.0047	624	7.541E-6	9.228	8.305
1453	30.70	1.4170	921163	0.0047	600	7.885E-6	9.413	8.472
1478	30.85	1.4217	921739	0.0048	578	8.232E-6	9.601	8.641
1503	31.00	1.4266	922315	0.0048	552	8.603E-6	9.794	8.815
1529	31.15	1.4314	922864	0.0096	1070	8.991E-6	9.992	8.993
1555	31.29	1.4362	923385	0.0095	1009	9.378E-6	10.195	9.175
	31.44	1.4409	923873					
	31.52	1.4435	924558					
1615	31.81	1.4528	925419	0.0190	1776	1.067E-5	10.702	9.632
1637	32.12	1.4624	926334	0.0192	1779	1.080E-5	10.911	9.820
1659	32.43	1.4720	927198	0.0189	1693	1.115E-5	11.127	10.014
1681	32.73	1.4813	928027	0.0096	815	1.179E-5	11.348	10.213
1704	33.05	1.4909	928822	0.0096	772	1.241E-5	11.577	10.419
1728	33.38	1.5009	929582	0.0095	735	1.304E-5	11.807	10.626
1751	33.70	1.5105	930308	0.0096	702	1.365E-5	12.046	10.841
1775	34.02	1.5199	930964	0.0095	665	1.426E-5	12.283	11.055
1799	34.34	1.5292	931605	0.0095	634	1.490E-5	12.525	11.272
1823	34.67	1.5386	932236	0.0095	609	1.561E-5	12.769	11.492
1847	35.00	1.5480	932812	0.0095	587	1.625E-5	13.024	11.721
1872	35.35	1.5577	933388	0.0095	561	1.697E-5	13.285	11.956
1899	35.71	1.5676	933964	0.0095	536	1.776E-5	13.550	12.195
1924	36.06	1.5771	934486	0.0095	517	1.846E-5	13.821	12.439
1949	36.40	1.5863	934973	0.0096	494	1.934E-5	14.094	12.685
1976	36.76	1.5959	935454	0.0095	467	2.033E-5	14.369	12.932
2002	37.11	1.6053	935913	0.0095	445	2.133E-5	14.656	13.191
2029	37.49	1.6151	936349	0.0096	429	2.235E-5	14.945	13.450
2056	37.86	1.6246	936765	0.0096	411	2.343E-5	15.244	13.719
2084	38.23	1.6341	937157	0.0097	391	2.467E-5	15.549	13.994
2112	38.62	1.6438	937548	0.0096	369	2.597E-5	15.861	14.275
2141	39.02	1.6537	937922	0.0095	349	2.742E-5	16.183	14.565
2170	39.42	1.6635	938259	0.0096	334	2.890E-5	16.500	14.850
2198	39.79	1.6725	938562	0.0096	314	3.047E-5	16.827	15.144
2226	40.18	1.6818	938861	0.0095	293	3.217E-5	17.155	15.439

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Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
2256	40.60	1.6916	939159	0.0094	278	3.393E-5	17.489	15.741
2286	41.01	1.7011	939430	0.0096	269	3.584E-5	17.836	16.053
2315	41.41	1.7105	939681	0.0097	256	3.776E-5	18.188	16.369
2346	41.83	1.7199	939927	0.0096	240	3.983E-5	18.555	16.699
2378	42.28	1.7301	940173	0.0096	228	4.204E-5	18.921	17.029
2409	42.72	1.7397	940396	0.0096	218	4.431E-5	19.301	17.371
2440	43.14	1.7490	940598	0.0098	207	4.713E-5	19.683	17.715
2472	43.59	1.7586	940799	0.0096	192	5.002E-5	20.071	18.064
2505	44.05	1.7683	940991	0.0095	180	5.312E-5	20.479	18.432
2539	44.53	1.7785	941167	0.0096	172	5.640E-5	20.876	18.789
2570	44.96	1.7875	941326	0.0097	162	5.995E-5	21.294	19.165
2602	45.42	1.7968	941478	0.0096	150	6.374E-5	21.712	19.541
2637	45.92	1.8069	941631	0.0095	141	6.797E-5	22.136	19.923
2671	46.40	1.8166	941768	0.0096	134	7.262E-5	22.576	20.319
2705	46.87	1.8258	941890	0.0097	126	7.733E-5	23.025	20.723
2740	47.37	1.8354	942012	0.0097	117	8.305E-5	23.477	21.129
2775	47.89	1.8453	942128	0.0196	222	8.837E-5	23.947	21.553
2811	48.40	1.8551	942234	0.0195	202	9.643E-5	24.425	21.983
	48.93	1.8648	942330					
	49.47	1.8747	942436					
2800	49.96	1.8836	942538	0.0185	207	8.933E-5	24.846	22.360
2800	50.50	1.8932	942643	0.0193	211	9.167E-5	25.015	22.513
2800	51.05	1.9030	942749	0.0194	207	9.372E-5	25.192	22.673
2800	51.61	1.9126	942850	0.0097	101	9.580E-5	25.371	22.834
2800	52.16	1.9221	942948	0.0097	100	9.770E-5	25.555	22.999
2800	52.75	1.9320	943046	0.0098	98	9.984E-5	25.738	23.164
2800	53.33	1.9417	943143	0.0098	96	1.017E-4	25.929	23.336
2800	53.94	1.9517	943241	0.0098	94	1.041E-4	26.120	23.508
2800	54.55	1.9615	943334	0.0097	91	1.067E-4	26.313	23.682
2800	55.16	1.9712	943424	0.0097	89	1.096E-4	26.509	23.858
2800	55.78	1.9809	943509	0.0097	86	1.127E-4	26.701	24.031
2800	56.38	1.9902	943590	0.0096	83	1.155E-4	26.902	24.212
2800	57.03	2.0002	943676	0.0097	81	1.188E-4	27.100	24.390
2800	57.69	2.0100	943757	0.0096	79	1.218E-4	27.303	24.572
2800	58.32	2.0193	943833	0.0097	78	1.246E-4	27.513	24.761
2800	59.00	2.0293	943910	0.0097	75	1.282E-4	27.716	24.944
2800	59.67	2.0388	943983	0.0097	73	1.316E-4	27.928	25.135
2800	60.34	2.0483	944056	0.0098	72	1.353E-4	28.140	25.326
2800	61.04	2.0581	944126	0.0098	70	1.389E-4	28.358	25.522
2800	61.77	2.0680	944196	0.0097	68	1.426E-4	28.584	25.726
2800	62.53	2.0783	944267	0.0098	66	1.473E-4	28.807	25.926
2800	63.25	2.0878	944330	0.0099	64	1.535E-4	29.036	26.132
2800	63.97	2.0972	944392	0.0098	61	1.603E-4	29.263	26.336
2800	64.73	2.1070	944452	0.0097	58	1.679E-4	29.503	26.552
2800	65.57	2.1176	944511	0.0098	56	1.751E-4	29.733	26.760

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Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK (ksi[in]^.5)	
2800	66.32	2.1269	944563	0.0098	55	1.802E-4	29.981	26.983	
2800	67.09	2.1364	944614	0.0099	53	1.843E-4	30.220	27.198	
2800	67.92	2.1464	944667	0.0097	52	1.869E-4	30.463	27.417	
2800	68.74	2.1561	944720	0.0098	51	1.907E-4	30.719	27.646	
2800	69.60	2.1661	944772	0.0098	50	1.962E-4	30.970	27.872	
2800	70.44	2.1757	944822	0.0098	48	2.056E-4	31.231	28.108	
2800	71.32	2.1857	944868	0.0098	45	2.174E-4	31.486	28.337	
2800	72.17	2.1952	944911	0.0098	43	2.293E-4	31.757	28.581	
2800	73.10	2.2053	944953	0.0097	41	2.411E-4	32.023	28.820	
2800	74.02	2.2151	944992	0.0097	39	2.521E-4	32.296	29.066	
2800	74.92	2.2247	945029	0.0098	38	2.612E-4	32.570	29.312	
2800	75.84	2.2342	945065	0.0098	36	2.699E-4	32.849	29.563	
2800	76.82	2.2441	945100	0.0097	35	2.792E-4	33.130	29.816	
2800	77.80	2.2540	945136	0.0098	33	2.925E-4	33.422	30.079	
2800	78.80	2.2638	945169	0.0099	32	3.057E-4	33.711	30.339	
2800	79.78	2.2733	945199	0.0098	31	3.198E-4	34.016	30.613	
2800	80.85	2.2835	945229	0.0098	29	3.391E-4	34.317	30.884	
2800	81.93	2.2935	945259	0.0098	27	3.580E-4	34.627	31.163	
2800	82.97	2.3031	945285	0.0099	26	3.772E-4	34.941	31.445	
2800	84.05	2.3128	945309	0.0099	25	3.990E-4	35.250	31.723	
2800	85.13	2.3223	945333	0.0099	23	4.256E-4	35.574	32.015	
2800	86.29	2.3324	945356	0.0101	22	4.590E-4	35.906	32.313	
2800	87.50	2.3427	945378	0.0100	21	4.863E-4	36.245	32.618	
2800	88.70	2.3527	945398	0.0101	20	5.123E-4	36.611	32.946	
2799	90.04	2.3639	945417	0.0101	19	5.399E-4	36.952	33.255	
2800	91.13	2.3730	945435	0.0102	18	5.757E-4	37.317	33.582	
2800	92.31	2.3827	945452	0.0101	17	6.112E-4	37.671	33.902	
2800	93.57	2.3928	945468	0.0100	15	6.597E-4	38.046	34.240	
2800	94.95	2.4037	945483	0.0102	14	7.230E-4	38.416	34.569	*
2799	96.21	2.4134	945497	0.0103	13	7.839E-4	38.816	34.929	*
2799	97.56	2.4237	945509	0.0103	12	8.419E-4	39.211	35.283	*
2799	99.00	2.4344	945521	0.0102	12	8.904E-4	39.609	35.641	*
2799	100.39	2.4444	945532	0.0103	11	9.478E-4	40.027	36.017	*
2799	101.81	2.4546	945542	0.0103	10	9.897E-4	40.441	36.387	*
2799	103.31	2.4650	945553	0.0103	10	1.048E-3	40.866	36.771	*
2799	104.81	2.4753	945562	0.0104	9	1.126E-3	41.289	37.147	*
2798	106.29	2.4852	945571	0.0104	9	1.196E-3	41.745	37.556	*
2798	107.96	2.4961	945580	0.0104	8	1.283E-3	42.193	37.957	*
2798	109.62	2.5068	945587	0.0107	8	1.392E-3	42.665	38.381	*
2798	111.26	2.5170	945595	0.0105	7	1.534E-3	43.132	38.797	*
2797	112.95	2.5274	945602	0.0105	6	1.693E-3	43.654	39.266	*
2797	114.97	2.5395	945608	0.0105	6	1.909E-3	44.079	39.636	*
2794	116.50	2.5485	945613	0.0105	5	2.114E-3	44.610	40.099	*
2791	118.40	2.5593	945618	0.0106	5	2.415E-3	45.100	40.539	*
2795	120.28	2.5699	945622	0.0101	4	2.670E-3	45.579	40.952	*

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Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK (ksi[in]^.5)	
2792	122.17	2.5802	945626	0.0104	4	2.815E-3	46.127	41.439	*
2789	124.18	2.5910	945629	0.0104	4	2.977E-3	46.627	41.882	*
2790	125.98	2.6004	945632	0.0105	3	3.221E-3	47.141	42.324	*
2787	128.07	2.6111	945636	0.0216	7	3.080E-3	47.631	42.746	*
2779	130.25	2.6219	945639	0.0216	5	4.324E-3	48.079	43.109	*
	132.46	2.6327	945641						

Automated Fatigue Crack
Growth Rate Analysis

Test ID	5083-FCG-2	Geometry	C(T)
Contract	SSC 10624-01	Orientation	T-L
Material	5083-H321	Yield (ksi)	34.3
Temperature (F)	75	Modulus (Msi)	10.5
Environment	RH = 40%		

Specimen Dimensions (in)

Thickness	0.498	Height	2.400
Net Thickness	0.498	Notch Depth	1.000
Width	4.000	Gage Length	0.500

Precrack Parameters

Pmax (lbs)	782.0	Stress Ratio	0.10
Final a (in)	1.050	Kmax (ksi sqr[in])	4.00

Test Parameters

EvBP	Freq	Pmax	R	Ai	Kmaxi	C	DKi
23.508	10.00	0	0.10	1.140	3.00	4.00	0.00
31.601	10.00	0	0.10	1.455	10.58	2.00	0.00
49.466	5.00	2800	0.10	0.000	0.00	0.00	0.00

K Coeff	C Coeff
.886	1.00098
4.64	-4.66951
-13.32	18.4601
14.72	-236.825
-5.6	1214.88
.	-2143.57

Visual Observations

EvB/P	Crack(EvB/P)	Crack(visual)	Error	CAF
20.449	0.996	1.000	0.004	1.019
21.848	1.067	1.075	0.008	1.015
23.496	1.145	1.150	0.005	1.010
27.159	1.296	1.295	-0.001	1.001
31.498	1.447	1.430	-0.017	0.992
42.053	1.727	1.720	-0.007	0.976
49.149	1.870	1.870	0.000	0.968
104.045	2.464	2.470	0.006	0.936

Comments

Date of test: 8/14/2006
Waveform Type Sine

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Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
	23.51	1.1452	5353					
546	23.56	1.1477	40922	0.0074	98021	7.540E-8	2.997	2.697
556	23.67	1.1526	103374	0.0097	117902	8.199E-8	3.043	2.739
566	23.78	1.1574	158824	0.0044	51514	8.606E-8	3.105	2.794
575	23.88	1.1619	211935	0.0048	53696	8.948E-8	3.168	2.851
585	23.99	1.1667	263545	0.0047	50237	9.425E-8	3.232	2.908
595	24.10	1.1716	314436	0.0047	47764	9.928E-8	3.299	2.969
606	24.22	1.1766	363099	0.0047	45445	1.049E-7	3.365	3.028
616	24.32	1.1811	404796	0.0048	43195	1.105E-7	3.434	3.090
626	24.43	1.1857	445408	0.0048	41024	1.167E-7	3.500	3.150
636	24.54	1.1904	484607	0.0047	38584	1.227E-7	3.571	3.214
647	24.65	1.1952	522712	0.0047	36811	1.288E-7	3.644	3.280
659	24.77	1.2003	560580	0.0047	34973	1.359E-7	3.717	3.346
670	24.88	1.2050	594601	0.0048	33124	1.438E-7	3.793	3.414
681	24.99	1.2096	625664	0.0048	31162	1.528E-7	3.868	3.481
692	25.10	1.2142	655247	0.0047	28992	1.633E-7	3.945	3.550
704	25.21	1.2189	683351	0.0047	27070	1.754E-7	4.024	3.622
716	25.33	1.2237	709682	0.0047	25245	1.880E-7	4.106	3.696
729	25.45	1.2286	734534	0.0047	23470	2.017E-7	4.190	3.771
741	25.56	1.2333	757019	0.0047	21784	2.169E-7	4.273	3.846
753	25.67	1.2378	777136	0.0047	20078	2.354E-7	4.357	3.921
765	25.79	1.2423	796069	0.0046	18209	2.584E-7	4.442	3.998
778	25.90	1.2470	814055	0.0046	16482	2.883E-7	4.532	4.078
792	26.02	1.2519	830152	0.0047	15049	3.256E-7	4.620	4.158
805	26.14	1.2564	843789	0.0048	13449	3.710E-7	4.715	4.243
819	26.26	1.2611	855912	0.0047	11679	4.264E-7	4.810	4.329
833	26.38	1.2661	867429	0.0047	10044	5.022E-7	4.908	4.417
848	26.51	1.2709	876763	0.0047	8692	5.905E-7	5.006	4.505
861	26.62	1.2754	884131	0.0047	7541	6.819E-7	5.108	4.597
876	26.74	1.2800	890415	0.0046	6409	7.704E-7	5.205	4.685
890	26.86	1.2845	895941	0.0047	5557	8.682E-7	5.310	4.779
906	26.98	1.2893	901160	0.0047	4959	9.746E-7	5.413	4.872
921	27.10	1.2939	905881	0.0047	4474	1.088E-6	5.526	4.973
937	27.23	1.2989	910107	0.0047	4057	1.202E-6	5.635	5.072
953	27.36	1.3036	913882	0.0047	3680	1.311E-6	5.752	5.177
969	27.48	1.3083	917260	0.0047	3338	1.433E-6	5.864	5.277
985	27.60	1.3127	920282	0.0046	3010	1.565E-6	5.981	5.383
1001	27.73	1.3173	923239	0.0046	2754	1.715E-6	6.099	5.489
1019	27.86	1.3222	925906	0.0047	2529	1.885E-6	6.219	5.597
1036	27.98	1.3267	928167	0.0047	2341	2.050E-6	6.344	5.710
1053	28.11	1.3314	930403	0.0047	2146	2.226E-6	6.471	5.824
1071	28.24	1.3362	932435	0.0047	1959	2.414E-6	6.601	5.941
1089	28.37	1.3409	934325	0.0047	1812	2.640E-6	6.733	6.060
1108	28.51	1.3457	936114	0.0047	1657	2.903E-6	6.868	6.181

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
1126	28.64	1.3503	937659	0.0047	1524	3.172E-6	7.006	6.305
1145	28.77	1.3550	939041	0.0047	1394	3.457E-6	7.145	6.430
1165	28.90	1.3597	940342	0.0047	1270	3.724E-6	7.289	6.560
1185	29.04	1.3645	941578	0.0047	1178	4.013E-6	7.435	6.691
1205	29.17	1.3692	942686	0.0047	1103	4.289E-6	7.580	6.822
1224	29.30	1.3736	943733	0.0047	1032	4.592E-6	7.735	6.961
1246	29.44	1.3785	944727	0.0047	965	4.918E-6	7.885	7.097
1267	29.58	1.3832	945657	0.0048	912	5.252E-6	8.046	7.242
1288	29.72	1.3880	946532	0.0048	856	5.623E-6	8.210	7.389
1311	29.86	1.3928	947365	0.0048	802	5.980E-6	8.377	7.539
1333	30.00	1.3977	948157	0.0047	753	6.334E-6	8.549	7.694
1357	30.15	1.4025	948867	0.0047	707	6.642E-6	8.720	7.848
1379	30.28	1.4071	949538	0.0047	667	6.989E-6	8.893	8.004
1401	30.42	1.4116	950175	0.0047	629	7.364E-6	9.064	8.158
1424	30.55	1.4160	950773	0.0046	601	7.731E-6	9.244	8.319
1449	30.70	1.4208	951366	0.0047	578	8.157E-6	9.424	8.482
1473	30.85	1.4256	951931	0.0047	558	8.532E-6	9.615	8.654
1498	30.99	1.4303	952470	0.0048	534	8.911E-6	9.814	8.832
1525	31.15	1.4353	953008	0.0097	1050	9.195E-6	10.009	9.008
1550	31.29	1.4400	953520	0.0093	968	9.641E-6	10.215	9.194
	31.44	1.4447	953976					
	31.60	1.4498	954790					
1612	31.80	1.4560	955367	0.0160	1474	1.087E-5	10.765	9.689
1634	32.11	1.4659	956264	0.0192	1750	1.095E-5	10.940	9.846
1656	32.41	1.4752	957117	0.0190	1660	1.146E-5	11.164	10.048
1679	32.73	1.4849	957924	0.0095	799	1.191E-5	11.381	10.243
1701	33.04	1.4943	958705	0.0095	766	1.238E-5	11.609	10.448
1724	33.36	1.5037	959432	0.0095	732	1.292E-5	11.839	10.655
1748	33.68	1.5132	960160	0.0095	700	1.350E-5	12.072	10.865
1772	34.01	1.5227	960860	0.0095	669	1.417E-5	12.314	11.083
1796	34.34	1.5322	961506	0.0095	642	1.482E-5	12.557	11.302
1820	34.67	1.5417	962126	0.0095	610	1.555E-5	12.807	11.527
1845	35.01	1.5512	962718	0.0095	584	1.627E-5	13.061	11.755
1870	35.35	1.5607	963284	0.0095	561	1.698E-5	13.318	11.986
1894	35.69	1.5700	963822	0.0095	534	1.770E-5	13.584	12.225
1920	36.05	1.5797	964361	0.0094	506	1.859E-5	13.856	12.470
1947	36.41	1.5895	964873	0.0095	487	1.955E-5	14.127	12.714
1972	36.75	1.5985	965328	0.0096	468	2.051E-5	14.409	12.968
1998	37.11	1.6078	965755	0.0095	442	2.148E-5	14.693	13.223
2026	37.49	1.6176	966204	0.0094	417	2.260E-5	14.986	13.488
2054	37.88	1.6275	966630	0.0095	399	2.380E-5	15.285	13.756
2081	38.24	1.6367	967012	0.0095	382	2.503E-5	15.592	14.033
2109	38.62	1.6461	967375	0.0095	361	2.633E-5	15.896	14.306
2136	39.00	1.6556	967721	0.0095	342	2.771E-5	16.209	14.588
2165	39.39	1.6651	968049	0.0095	327	2.907E-5	16.528	14.875

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
2194	39.78	1.6744	968369	0.0095	310	3.056E-5	16.861	15.175
2224	40.20	1.6843	968684	0.0095	295	3.224E-5	17.193	15.473
2253	40.60	1.6938	968973	0.0096	281	3.415E-5	17.535	15.782
2282	41.01	1.7031	969233	0.0096	264	3.644E-5	17.882	16.094
2313	41.42	1.7126	969491	0.0095	247	3.879E-5	18.236	16.413
2344	41.86	1.7225	969737	0.0096	233	4.129E-5	18.600	16.740
2375	42.29	1.7320	969952	0.0096	222	4.358E-5	18.970	17.073
2405	42.71	1.7413	970163	0.0096	210	4.596E-5	19.354	17.419
2438	43.17	1.7513	970373	0.0096	198	4.842E-5	19.734	17.761
2470	43.62	1.7609	970565	0.0096	188	5.084E-5	20.132	18.119
2502	44.07	1.7704	970748	0.0095	178	5.352E-5	20.530	18.478
2535	44.53	1.7800	970922	0.0095	167	5.674E-5	20.934	18.841
2568	44.98	1.7894	971082	0.0095	157	6.045E-5	21.336	19.203
2599	45.43	1.7984	971232	0.0095	148	6.461E-5	21.758	19.583
2633	45.91	1.8080	971374	0.0095	138	6.909E-5	22.180	19.962
2667	46.40	1.8178	971509	0.0095	129	7.409E-5	22.623	20.361
2702	46.90	1.8274	971635	0.0096	121	7.942E-5	23.072	20.765
2736	47.39	1.8369	971752	0.0096	114	8.479E-5	23.525	21.173
2770	47.88	1.8463	971858	0.0189	207	9.112E-5	23.988	21.590
2806	48.39	1.8558	971959	0.0190	197	9.659E-5	24.454	22.009
	48.91	1.8653	972055					
	49.47	1.8756	972161					
2800	49.96	1.8845	972258	0.0187	197	9.500E-5	24.922	22.430
2800	50.51	1.8943	972358	0.0194	201	9.659E-5	25.092	22.582
2800	51.06	1.9039	972459	0.0192	197	9.723E-5	25.270	22.743
2800	51.62	1.9134	972555	0.0096	95	1.009E-4	25.447	22.902
2800	52.16	1.9228	972647	0.0096	93	1.035E-4	25.629	23.066
2800	52.75	1.9326	972738	0.0097	91	1.066E-4	25.812	23.231
2800	53.34	1.9424	972829	0.0097	89	1.096E-4	26.001	23.401
2800	53.94	1.9521	972916	0.0097	87	1.117E-4	26.192	23.573
2800	54.55	1.9618	973002	0.0097	85	1.137E-4	26.386	23.747
2800	55.17	1.9717	973086	0.0096	83	1.159E-4	26.576	23.918
2800	55.76	1.9808	973166	0.0096	81	1.177E-4	26.775	24.097
2800	56.40	1.9907	973248	0.0096	79	1.207E-4	26.968	24.271
2800	57.03	2.0003	973327	0.0096	77	1.239E-4	27.169	24.452
2800	57.67	2.0098	973404	0.0097	76	1.276E-4	27.374	24.636
2800	58.34	2.0197	973477	0.0096	73	1.308E-4	27.577	24.819
2800	59.00	2.0293	973550	0.0097	72	1.347E-4	27.788	25.009
2800	59.68	2.0390	973620	0.0097	70	1.377E-4	27.993	25.194
2800	60.33	2.0481	973687	0.0096	69	1.398E-4	28.214	25.393
2800	61.08	2.0584	973758	0.0096	67	1.428E-4	28.423	25.580
2800	61.77	2.0679	973824	0.0097	66	1.470E-4	28.647	25.782
2800	62.48	2.0774	973889	0.0098	64	1.516E-4	28.866	25.979
2800	63.20	2.0869	973952	0.0097	62	1.571E-4	29.097	26.187
2800	64.00	2.0973	974014	0.0097	60	1.636E-4	29.321	26.389

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Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK	
2800	64.74	2.1067	974071	0.0098	58	1.697E-4	29.562	26.605	
2800	65.51	2.1165	974127	0.0097	55	1.762E-4	29.796	26.816	
2800	66.31	2.1263	974182	0.0096	53	1.825E-4	30.034	27.030	
2800	67.10	2.1360	974234	0.0097	51	1.888E-4	30.273	27.245	
2800	67.87	2.1452	974281	0.0097	50	1.947E-4	30.516	27.463	
2800	68.68	2.1548	974329	0.0097	48	2.024E-4	30.761	27.685	
2800	69.54	2.1648	974379	0.0097	46	2.111E-4	31.014	27.912	
2800	70.40	2.1746	974425	0.0098	45	2.197E-4	31.274	28.146	
2800	71.28	2.1845	974467	0.0098	43	2.287E-4	31.536	28.382	
2800	72.16	2.1943	974509	0.0098	41	2.383E-4	31.802	28.621	
2800	73.07	2.2041	974549	0.0098	39	2.476E-4	32.068	28.861	
2800	73.96	2.2136	974587	0.0098	38	2.575E-4	32.341	29.106	
2800	74.89	2.2234	974625	0.0098	36	2.688E-4	32.617	29.355	
2800	75.86	2.2334	974661	0.0097	35	2.798E-4	32.902	29.611	
2800	76.85	2.2435	974695	0.0098	34	2.909E-4	33.185	29.866	
2800	77.80	2.2529	974727	0.0098	32	3.046E-4	33.470	30.122	
2800	78.74	2.2621	974757	0.0098	31	3.182E-4	33.764	30.387	
2800	79.80	2.2723	974789	0.0097	29	3.364E-4	34.056	30.649	
2800	80.85	2.2823	974817	0.0098	28	3.579E-4	34.364	30.926	
2800	81.91	2.2921	974844	0.0099	26	3.843E-4	34.675	31.206	
2800	82.99	2.3019	974869	0.0098	24	4.105E-4	34.987	31.487	
2800	84.09	2.3118	974892	0.0098	23	4.371E-4	35.306	31.773	
2800	85.20	2.3216	974913	0.0099	21	4.650E-4	35.621	32.056	
2800	86.28	2.3309	974933	0.0098	20	4.871E-4	35.954	32.356	
2800	87.49	2.3411	974953	0.0098	19	5.112E-4	36.287	32.656	
2800	88.72	2.3514	974972	0.0098	18	5.382E-4	36.621	32.956	
2800	89.85	2.3607	974990	0.0098	17	5.723E-4	36.977	33.276	
2800	91.11	2.3707	975007	0.0098	16	6.044E-4	37.312	33.577	
2800	92.33	2.3803	975022	0.0097	16	6.339E-4	37.666	33.896	
2799	93.57	2.3899	975036	0.0098	15	6.730E-4	38.026	34.219	
2799	94.89	2.3999	975051	0.0098	14	7.110E-4	38.384	34.540	
2799	96.20	2.4096	975065	0.0098	13	7.489E-4	38.763	34.880	*
2799	97.57	2.4196	975077	0.0099	13	7.860E-4	39.135	35.215	*
2799	98.92	2.4292	975089	0.0099	12	8.373E-4	39.526	35.566	*
2799	100.37	2.4394	975101	0.0103	11	9.104E-4	39.917	35.918	*
2799	101.81	2.4493	975112	0.0104	11	9.984E-4	40.322	36.280	*
2799	103.31	2.4594	975122	0.0101	10	1.082E-3	40.748	36.656	*
2795	105.09	2.4713	975132	0.0103	9	1.177E-3	41.191	37.057	*
2797	106.66	2.4819	975140	0.0103	8	1.256E-3	41.593	37.412	*
2797	107.89	2.4899	975147	0.0103	8	1.336E-3	42.089	37.860	*
2798	109.66	2.5013	975155	0.0101	7	1.443E-3	42.494	38.226	*
2798	111.26	2.5113	975162	0.0101	7	1.591E-3	42.968	38.645	*
2796	112.86	2.5212	975168	0.0105	6	1.692E-3	43.454	39.081	*
2797	114.66	2.5320	975174	0.0104	6	1.810E-3	43.921	39.499	*
2797	116.46	2.5427	975179	0.0104	6	1.891E-3	44.428	39.951	*

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Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK	
2797	118.25	2.5530	975185	0.0104	5	1.991E-3	44.940	40.407	*
2795	120.18	2.5638	975190	0.0104	5	2.122E-3	45.418	40.832	*
2793	121.95	2.5735	975195	0.0104	5	2.398E-3	45.910	41.256	*
2790	123.80	2.5835	975199	0.0107	4	2.766E-3	46.433	41.721	*
2792	125.86	2.5943	975203	0.0107	4	3.134E-3	46.887	42.101	*
2783	127.99	2.6053	975206	0.0107	3	3.510E-3	47.418	42.547	*
2772	130.39	2.6173	975209	0.0226	6	3.767E-3	47.854	42.899	*
2763	132.56	2.6279	975212	0.0201	5	4.023E-3	48.314	43.261	*
	134.56	2.6374	975214						

Automated Fatigue Crack
Growth Rate Analysis

Test ID	5083-FCG-3	Geometry	C(T)
Contract	SSC 10624-01	Orientation	T-L
Material	5083-H321	Yield (ksi)	34.3
Temperature (F)	75	Modulus (Msi)	10.5
Environment	Sea Water		

Specimen Dimensions (in)

Thickness	0.498	Height	2.400
Net Thickness	0.498	Notch Depth	1.000
Width	4.001	Gage Length	0.500

Precrack Parameters

Pmax (lbs)	783.0	Stress Ratio	0.10
Final a (in)	1.050	Kmax (ksi sqr[in])	4.00

Test Parameters

EvBP	Freq	Pmax	R	Ai	Kmaxi	C	DKi
33.806	5.00	0	0.10	1.200	2.40	2.00	0.00
33.806	5.00	0	0.10	1.531	9.01	2.00	0.00
62.078	5.00	2300	0.10	0.000	0.00	0.00	0.00

K Coeff	C Coeff
.886	1.00098
4.64	-4.66951
-13.32	18.4601
14.72	-236.825
-5.6	1214.88
.	-2143.57

Visual Observations

EvB/P	Crack(EvB/P)	Crack(visual)	Error	CAF
20.705	1.012	1.000	-0.012	1.020
21.841	1.068	1.060	-0.008	1.016
23.618	1.150	1.160	0.010	1.009
24.536	1.190	1.190	0.000	1.006
24.722	1.197	1.200	0.003	1.006
25.856	1.244	1.250	0.006	1.002
29.095	1.363	1.370	0.007	0.993
33.824	1.512	1.510	-0.002	0.982
47.605	1.831	1.830	-0.001	0.959
58.004	2.003	2.000	-0.003	0.947

Comments

Date of test: 8/21/2006
Waveform Type Sine

Test ID 5083-FCG-3 Page 1

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
	24.73	1.1979	1932					
417	24.77	1.1996	27582	0.0057	85243	6.655E-8	2.359	2.124
423	24.87	1.2035	87175	0.0085	123618	6.901E-8	2.392	2.153
430	24.98	1.2081	151200	0.0040	51273	7.998E-8	2.436	2.192
437	25.09	1.2127	207030	0.0045	54630	8.420E-8	2.485	2.237
445	25.21	1.2175	258821	0.0047	51470	9.169E-8	2.535	2.281
452	25.32	1.2221	309570	0.0046	47230	9.928E-8	2.586	2.327
460	25.44	1.2268	355363	0.0046	43823	1.069E-7	2.638	2.374
468	25.55	1.2315	395997	0.0046	40644	1.155E-7	2.690	2.421
475	25.67	1.2360	434579	0.0046	37438	1.248E-7	2.743	2.469
483	25.78	1.2405	469966	0.0047	34855	1.347E-7	2.797	2.517
491	25.90	1.2452	502687	0.0047	32526	1.452E-7	2.852	2.567
500	26.02	1.2498	534196	0.0047	30338	1.561E-7	2.912	2.620
509	26.14	1.2548	564493	0.0047	28278	1.664E-7	2.970	2.673
517	26.26	1.2596	591155	0.0046	26379	1.775E-7	3.031	2.728
526	26.38	1.2641	616605	0.0047	24682	1.896E-7	3.090	2.781
534	26.50	1.2685	639631	0.0046	22864	2.019E-7	3.152	2.837
544	26.62	1.2731	660960	0.0046	21491	2.154E-7	3.213	2.892
553	26.74	1.2778	682289	0.0046	19996	2.317E-7	3.278	2.950
562	26.86	1.2824	701679	0.0047	18614	2.515E-7	3.344	3.010
572	26.99	1.2872	720100	0.0046	17256	2.744E-7	3.411	3.070
582	27.11	1.2917	736580	0.0046	15666	3.013E-7	3.480	3.132
592	27.24	1.2965	751313	0.0046	14358	3.296E-7	3.549	3.194
602	27.36	1.3010	764496	0.0046	13108	3.577E-7	3.619	3.257
611	27.48	1.3054	776283	0.0046	12016	3.862E-7	3.691	3.322
622	27.60	1.3101	787825	0.0046	11133	4.144E-7	3.763	3.387
632	27.73	1.3147	798747	0.0046	10342	4.473E-7	3.839	3.455
643	27.86	1.3194	808675	0.0046	9702	4.790E-7	3.915	3.524
654	27.99	1.3240	818108	0.0046	9037	5.161E-7	3.994	3.594
665	28.12	1.3286	826549	0.0046	8342	5.571E-7	4.071	3.664
676	28.24	1.3330	834497	0.0046	7746	6.031E-7	4.154	3.738
687	28.37	1.3378	842046	0.0046	7127	6.579E-7	4.235	3.812
699	28.50	1.3424	848798	0.0046	6567	7.198E-7	4.321	3.889
711	28.64	1.3471	855150	0.0047	6004	7.953E-7	4.407	3.967
723	28.77	1.3518	860867	0.0093	10798	8.655E-7	4.497	4.047
736	28.91	1.3564	865948	0.0093	9654	9.630E-7	4.586	4.128
748	29.04	1.3611	870521	0.0461	73444	6.278E-7	0.000	0.000
869	30.27	1.4025	939392	0.0461	71574	6.442E-7	0.000	0.000
884	30.41	1.4072	942095	0.0092	5243	1.759E-6	5.695	5.126
899	30.55	1.4118	944635	0.0096	4953	1.929E-6	5.813	5.232
915	30.71	1.4167	947048	0.0097	4471	2.177E-6	5.930	5.337
931	30.86	1.4215	949106	0.0047	2012	2.411E-6	6.051	5.446
947	31.00	1.4260	950915	0.0045	1895	2.440E-6	6.174	5.557
963	31.15	1.4307	952622	0.0048	1772	2.636E-6	6.296	5.666

Test ID 5083-FCG-3 Page 2

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
979	31.29	1.4354	954167	0.0046	1633	2.780E-6	6.407	5.766
992	31.40	1.4387	956007	0.0047	1548	2.992E-6	6.558	5.902
1014	31.61	1.4453	957682	0.0046	1448	3.295E-6	6.664	5.997
1029	31.73	1.4492	958902	0.0046	1345	3.649E-6	6.822	6.139
1047	31.89	1.4539	960203	0.0048	1186	4.096E-6	6.947	6.252
1064	32.04	1.4585	961309	0.0045	1046	4.508E-6	7.086	6.377
1082	32.18	1.4631	962235	0.0047	967	4.997E-6	7.225	6.503
1100	32.34	1.4677	963123	0.0047	862	5.526E-6	7.371	6.634
1119	32.49	1.4725	963956	0.0047	784	6.038E-6	7.519	6.767
1138	32.65	1.4772	964706	0.0047	729	6.539E-6	7.672	6.904
1158	32.81	1.4819	965374	0.0047	675	6.997E-6	7.824	7.041
1177	32.96	1.4864	966012	0.0047	626	7.472E-6	7.983	7.185
1197	33.12	1.4912	966610	0.0046	587	7.902E-6	8.138	7.324
1217	33.27	1.4957	967175	0.0046	555	8.333E-6	8.304	7.473
1238	33.44	1.5004	967714	0.0093	1051	8.826E-6	8.464	7.618
1258	33.59	1.5049	968226	0.0091	989	9.235E-6	8.634	7.771
	33.75	1.5095	968703					
	33.81	1.5111	969068					
1295	33.92	1.5145	969361	0.0079	742	1.071E-5	8.952	8.057
1304	34.08	1.5190	969810	0.0095	847	1.122E-5	9.030	8.127
1313	34.26	1.5240	970208	0.0093	745	1.245E-5	9.115	8.204
1321	34.41	1.5283	970555	0.0050	443	1.174E-5	9.205	8.285
1330	34.57	1.5329	970967	0.0058	497	1.262E-5	9.294	8.364
1339	34.74	1.5376	971394	0.0065	554	1.271E-5	9.407	8.466
1353	35.00	1.5446	972016	0.0074	622	1.253E-5	9.545	8.591
1371	35.34	1.5539	972793	0.0083	670	1.262E-5	9.709	8.738
1389	35.68	1.5633	973533	0.0090	707	1.279E-5	9.904	8.913
1408	36.04	1.5730	974287	0.0094	706	1.330E-5	10.099	9.089
1428	36.40	1.5825	974987	0.0094	675	1.391E-5	10.302	9.272
1447	36.76	1.5918	975634	0.0094	646	1.456E-5	10.504	9.454
1466	37.12	1.6010	976253	0.0093	611	1.526E-5	10.710	9.639
1485	37.48	1.6103	976845	0.0093	584	1.596E-5	10.919	9.827
1505	37.85	1.6197	977411	0.0094	561	1.669E-5	11.131	10.018
1525	38.22	1.6289	977950	0.0094	541	1.740E-5	11.352	10.217
1545	38.61	1.6384	978488	0.0094	521	1.809E-5	11.576	10.418
1566	39.01	1.6480	979000	0.0094	501	1.879E-5	11.810	10.629
1588	39.40	1.6576	979499	0.0095	486	1.953E-5	12.043	10.839
1609	39.80	1.6669	979968	0.0094	464	2.025E-5	12.285	11.057
1630	40.20	1.6763	980416	0.0094	445	2.098E-5	12.528	11.275
1652	40.61	1.6859	980864	0.0093	428	2.177E-5	12.770	11.493
1673	41.01	1.6949	981270	0.0094	413	2.263E-5	13.023	11.721
1695	41.42	1.7041	981669	0.0094	399	2.349E-5	13.273	11.946
1718	41.84	1.7135	982067	0.0094	382	2.447E-5	13.539	12.185
1741	42.28	1.7233	982447	0.0094	369	2.546E-5	13.804	12.424
1764	42.71	1.7327	982809	0.0094	356	2.649E-5	14.079	12.671

Test ID 5083-FCG-3 Page 3

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
1787	43.15	1.7420	983155	0.0095	342	2.761E-5	14.354	12.919
1810	43.59	1.7513	983483	0.0094	329	2.864E-5	14.636	13.172
1834	44.04	1.7607	983803	0.0094	317	2.976E-5	14.926	13.434
1858	44.51	1.7704	984119	0.0095	305	3.094E-5	15.221	13.699
1882	44.97	1.7798	984421	0.0095	296	3.213E-5	15.525	13.973
1907	45.44	1.7893	984709	0.0096	286	3.339E-5	15.829	14.246
1931	45.92	1.7987	984983	0.0095	273	3.469E-5	16.146	14.531
1957	46.42	1.8085	985258	0.0095	260	3.654E-5	16.465	14.818
1982	46.91	1.8181	985518	0.0095	249	3.811E-5	16.789	15.110
2007	47.39	1.8272	985754	0.0095	241	3.949E-5	17.129	15.415
2034	47.92	1.8371	985980	0.0094	230	4.096E-5	17.453	15.708
2059	48.40	1.8461	986204	0.0094	221	4.256E-5	17.802	16.022
2085	48.92	1.8556	986427	0.0095	212	4.430E-5	18.145	16.331
2112	49.45	1.8651	986640	0.0094	203	4.635E-5	18.506	16.655
2139	49.99	1.8748	986841	0.0095	194	4.920E-5	18.867	16.980
2166	50.52	1.8841	987024	0.0095	183	5.209E-5	19.242	17.317
2193	51.06	1.8934	987199	0.0095	173	5.499E-5	19.620	17.658
2221	51.64	1.9032	987369	0.0094	163	5.800E-5	20.003	18.003
2249	52.19	1.9126	987526	0.0095	156	6.103E-5	20.395	18.355
2276	52.75	1.9219	987675	0.0096	148	6.442E-5	20.790	18.710
2304	53.33	1.9312	987817	0.0096	138	6.910E-5	21.200	19.080
2333	53.94	1.9412	987960	0.0095	130	7.445E-5	21.615	19.453
2363	54.55	1.9509	988088	0.0095	122	7.954E-5	22.055	19.849
2393	55.18	1.9608	988198	0.0096	115	8.411E-5	22.482	20.234
2422	55.76	1.9697	988303	0.0096	108	8.935E-5	22.928	20.635
2451	56.38	1.9792	988408	0.0190	206	9.246E-5	23.383	21.034
2483	57.02	1.9888	988509	0.0198	197	1.003E-4	23.848	21.455
	57.71	1.9989	988605					
	62.08	2.0637	989903					
2300	62.51	2.0697	989969	0.0161	180	8.943E-5	23.567	21.211
2300	63.23	2.0798	990083	0.0200	228	8.770E-5	23.720	21.348
2300	63.96	2.0897	990197	0.0203	229	8.882E-5	23.915	21.523
2300	64.73	2.1001	990312	0.0103	111	9.251E-5	24.114	21.702
2300	65.52	2.1106	990422	0.0103	108	9.529E-5	24.316	21.885
2300	66.30	2.1208	990527	0.0103	104	9.873E-5	24.526	22.073
2300	67.12	2.1313	990632	0.0102	100	1.023E-4	24.732	22.258
2300	67.92	2.1413	990728	0.0102	97	1.053E-4	24.942	22.448
2300	68.73	2.1514	990819	0.0102	95	1.083E-4	25.153	22.637
2300	69.56	2.1615	990911	0.0102	92	1.115E-4	25.367	22.831
2300	70.41	2.1717	991003	0.0102	89	1.137E-4	25.589	23.030
2300	71.31	2.1823	991094	0.0102	88	1.165E-4	25.814	23.232
2300	72.20	2.1926	991181	0.0102	85	1.195E-4	26.039	23.435
2300	73.06	2.2024	991263	0.0102	83	1.228E-4	26.272	23.644
2300	73.99	2.2128	991344	0.0101	80	1.262E-4	26.494	23.845
2300	74.88	2.2226	991421	0.0101	78	1.296E-4	26.732	24.059

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Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK (ksi[in]^.5)	
2300	75.81	2.2327	991498	0.0102	76	1.333E-4	26.968	24.271	
2300	76.79	2.2431	991574	0.0102	74	1.371E-4	27.209	24.488	
2300	77.75	2.2532	991647	0.0103	73	1.412E-4	27.461	24.715	
2300	78.77	2.2636	991720	0.0103	71	1.451E-4	27.714	24.943	
2300	79.82	2.2741	991790	0.0102	68	1.499E-4	27.975	25.177	
2300	80.86	2.2845	991858	0.0103	66	1.555E-4	28.232	25.409	
2300	81.87	2.2943	991921	0.0103	63	1.625E-4	28.498	25.648	
2300	82.95	2.3046	991983	0.0102	60	1.711E-4	28.764	25.887	
2300	84.07	2.3150	992043	0.0102	56	1.819E-4	29.042	26.137	
2300	85.23	2.3256	992099	0.0103	54	1.915E-4	29.316	26.384	
2300	86.32	2.3354	992148	0.0103	52	1.985E-4	29.603	26.642	
2300	87.48	2.3457	992196	0.0102	50	2.053E-4	29.885	26.896	
2300	88.66	2.3560	992246	0.0101	48	2.112E-4	30.177	27.159	
2300	89.88	2.3663	992296	0.0103	47	2.178E-4	30.472	27.424	
2300	91.09	2.3764	992341	0.0104	46	2.260E-4	30.768	27.690	
2300	92.29	2.3862	992384	0.0102	43	2.364E-4	31.079	27.970	
2300	93.62	2.3969	992428	0.0102	41	2.491E-4	31.393	28.253	
2300	95.00	2.4078	992470	0.0103	39	2.619E-4	31.708	28.536	
2300	96.25	2.4174	992506	0.0104	38	2.750E-4	32.039	28.834	
2300	97.60	2.4276	992542	0.0102	35	2.921E-4	32.359	29.122	
2300	99.00	2.4380	992577	0.0102	33	3.111E-4	32.695	29.424	
2300	100.44	2.4484	992610	0.0103	32	3.278E-4	33.032	29.728	
2300	101.85	2.4584	992638	0.0102	30	3.413E-4	33.385	30.045	
2300	103.35	2.4689	992667	0.0102	28	3.582E-4	33.732	30.358	
2300	104.84	2.4791	992696	0.0103	27	3.798E-4	34.090	30.679	
2300	106.34	2.4891	992723	0.0103	26	4.040E-4	34.451	31.004	
2300	107.88	2.4992	992747	0.0103	24	4.307E-4	34.827	31.342	
2300	109.57	2.5099	992770	0.0103	23	4.583E-4	35.198	31.675	
2300	111.17	2.5200	992791	0.0102	21	4.833E-4	35.598	32.035	
2300	112.87	2.5304	992812	0.0102	20	5.081E-4	35.993	32.391	
2300	114.65	2.5411	992833	0.0101	19	5.425E-4	36.380	32.738	
2300	116.24	2.5504	992850	0.0102	17	5.912E-4	36.792	33.109	*
2300	118.00	2.5605	992867	0.0102	16	6.549E-4	37.185	33.462	*
2300	119.79	2.5706	992882	0.0101	15	7.173E-4	37.605	33.839	*
2300	121.68	2.5810	992895	0.0103	14	7.773E-4	38.046	34.234	*
2300	123.68	2.5917	992908	0.0103	12	8.570E-4	38.480	34.624	*
2300	125.60	2.6018	992920	0.0110	11	9.696E-4	38.939	35.036	*
2299	127.61	2.6121	992931	0.0103	10	1.050E-3	39.397	35.445	*
2300	129.68	2.6225	992940	0.0103	10	1.095E-3	39.952	35.945	*
2300	132.57	2.6365	992950	0.0104	9	1.148E-3	40.343	36.297	*
2300	133.91	2.6429	992957	0.0103	9	1.192E-3	40.923	36.819	*
2300	136.13	2.6533	992966	0.0103	8	1.231E-3	41.343	37.198	*
2300	138.55	2.6643	992975	0.0098	8	1.335E-3	41.833	37.637	*
2299	140.76	2.6741	992982	0.0106	7	1.517E-3	42.371	38.119	*
2299	143.17	2.6846	992989	0.0097	7	1.586E-3	42.889	38.579	*

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Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK (ksi[in]^.5)	
2298	145.73	2.6954	992995	0.0103	6	1.764E-3	43.453	39.082	*
2298	148.40	2.7064	993000	0.0129	5	2.440E-3	43.865	39.448	*
2298	149.67	2.7116	993005	0.0101	4	2.800E-3	44.542	40.046	*
2296	153.30	2.7259	993010	0.0403	8	5.033E-3	45.401	40.818	*
2295	160.22	2.7518	993013	0.0195	5	3.904E-3	45.568	40.951	*
	158.47	2.7454	993015						

Automated Fatigue Crack
Growth Rate Analysis

Test ID	5083-FCG-45	Geometry	C(T)
Contract	SSC 10624-01	Orientation	T-L
Material	5083-H321	Yield (ksi)	34.3
Temperature (F)	75	Modulus (Msi)	10.5
Environment	Sea Water		

Specimen Dimensions (in)

Thickness	0.499	Height	2.400
Net Thickness	0.499	Notch Depth	1.000
Width	4.000	Gage Length	0.500

Precrack Parameters

Pmax (lbs)	784.0	Stress Ratio	0.10
Final a (in)	1.050	Kmax (ksi sqr[in])	4.00

Test Parameters

EvBP	Freq	Pmax	R	Ai	Kmaxi	C	DKi
24.522	5.00	0	0.10	1.195	2.70	4.00	0.00
32.544	5.00	0	0.10	1.491	8.80	2.00	0.00
55.204	5.00	2450	0.10	0.000	0.00	0.00	0.00

K Coeff	C Coeff
.886	1.00098
4.64	-4.66951
-13.32	18.4601
14.72	-236.825
-5.6	1214.88
.	-2143.57

Visual Observations

EvB/P	Crack(EvB/P)	Crack(visual)	Error	CAF
20.869	1.012	1.000	-0.012	1.013
21.842	1.062	1.065	0.003	1.010
23.217	1.127	1.125	-0.002	1.006
24.253	1.174	1.170	-0.004	1.004
24.439	1.182	1.195	0.013	1.003
28.306	1.335	1.350	0.015	0.995
32.493	1.475	1.480	0.005	0.987
34.530	1.535	1.530	-0.005	0.984
36.488	1.589	1.580	-0.009	0.982
46.151	1.812	1.805	-0.007	0.970
54.785	1.965	1.955	-0.010	0.962
72.549	2.199	2.210	0.011	0.951

Comments

Date of test: 9/10/2006
Waveform Type Sine

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Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
	24.52	1.1852	52230					
449	24.60	1.1888	140390	0.0079	158059	5.019E-8	2.513	2.262
456	24.71	1.1932	210289	0.0078	151828	5.159E-8	2.550	2.295
461	24.79	1.1966	292218	0.0040	74574	5.363E-8	2.649	2.384
487	24.90	1.2012	372041	0.0043	67562	6.198E-8	2.689	2.420
493	24.98	1.2047	425966	0.0044	64350	7.006E-8	2.790	2.511
501	25.08	1.2090	499674	0.0044	59975	7.804E-8	2.842	2.558
510	25.21	1.2143	545760	0.0045	53716	8.544E-8	2.899	2.609
519	25.33	1.2194	596390	0.0048	50101	9.771E-8	2.953	2.658
526	25.42	1.2230	652069	0.0049	41088	1.205E-7	3.019	2.717
536	25.55	1.2284	694335	0.0048	36412	1.578E-7	3.073	2.766
545	25.68	1.2336	726571	0.0047	30946	2.041E-7	3.140	2.826
555	25.79	1.2384	746204	0.0049	24251	2.327E-7	3.203	2.882
564	25.91	1.2429	764234	0.0048	19921	2.538E-7	3.268	2.941
573	26.02	1.2476	782068	0.0047	17651	2.683E-7	3.332	2.998
583	26.14	1.2523	797577	0.0047	17687	2.705E-7	3.399	3.059
593	26.26	1.2570	813862	0.0047	17862	2.701E-7	3.466	3.120
603	26.38	1.2617	832474	0.0047	17733	2.645E-7	3.537	3.183
613	26.49	1.2664	852328	0.0047	17862	2.595E-7	3.607	3.247
624	26.62	1.2712	871405	0.0048	17603	2.711E-7	3.679	3.311
634	26.74	1.2760	888464	0.0048	16595	2.920E-7	3.754	3.378
645	26.86	1.2807	904747	0.0048	14878	3.297E-7	3.831	3.448
657	27.00	1.2859	919480	0.0047	13156	3.783E-7	3.906	3.516
668	27.11	1.2903	932043	0.0048	11769	4.365E-7	3.987	3.588
679	27.24	1.2950	941598	0.0048	10314	4.900E-7	4.064	3.658
690	27.35	1.2995	950338	0.0047	8984	5.469E-7	4.148	3.733
702	27.49	1.3046	959080	0.0047	7895	6.074E-7	4.229	3.806
714	27.61	1.3093	966630	0.0047	7245	6.672E-7	4.317	3.886
726	27.74	1.3141	973381	0.0048	6678	7.367E-7	4.400	3.960
738	27.86	1.3185	979415	0.0047	5941	8.173E-7	4.491	4.042
751	27.99	1.3234	985069	0.0099	10989	9.020E-7	4.580	4.122
764	28.13	1.3284	990404	0.0097	9654	1.004E-6	4.673	4.205
777	28.26	1.3331	994723	0.0654	39796	1.643E-6	0.000	0.000
965	29.99	1.3938	1030200	0.0653	37065	1.762E-6	0.000	0.000
981	30.12	1.3984	1031788	0.0096	3071	3.115E-6	6.281	5.653
998	30.27	1.4034	1033271	0.0097	2763	3.526E-6	6.404	5.764
1015	30.41	1.4081	1034551	0.0096	2475	3.864E-6	6.535	5.881
1032	30.56	1.4129	1035746	0.0048	1183	4.122E-6	6.665	5.999
1049	30.70	1.4177	1036891	0.0048	1077	4.458E-6	6.800	6.120
1067	30.85	1.4225	1037937	0.0047	998	4.806E-6	6.936	6.243
1085	31.00	1.4273	1038883	0.0047	925	5.201E-6	7.074	6.366
1103	31.14	1.4319	1039733	0.0047	854	5.608E-6	7.214	6.492
1121	31.28	1.4365	1040536	0.0048	797	6.010E-6	7.358	6.622
1141	31.43	1.4414	1041298	0.0048	751	6.399E-6	7.504	6.754

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
1160	31.58	1.4461	1042012	0.0048	711	6.782E-6	7.658	6.892
1181	31.73	1.4510	1042716	0.0048	667	7.198E-6	7.816	7.034
1201	31.89	1.4560	1043388	0.0048	625	7.655E-6	7.974	7.177
1221	32.04	1.4607	1043997	0.0048	591	8.173E-6	8.135	7.322
1242	32.19	1.4653	1044539	0.0092	1050	8.788E-6	8.295	7.465
1262	32.34	1.4699	1045047	0.0095	1016	9.359E-6	8.462	7.616
	32.50	1.4748	1045555					
	36.74	1.5959	1054252					
1551	37.09	1.6053	1054821	0.0191	1138	1.676E-5	11.357	10.222
1572	37.47	1.6150	1055390	0.0193	1120	1.723E-5	11.581	10.423
1593	37.84	1.6246	1055941	0.0192	1078	1.784E-5	11.811	10.630
1614	38.22	1.6342	1056468	0.0096	511	1.886E-5	12.047	10.842
1636	38.61	1.6440	1056972	0.0097	491	1.974E-5	12.286	11.058
1658	39.00	1.6536	1057440	0.0097	470	2.066E-5	12.531	11.278
1680	39.39	1.6632	1057887	0.0096	447	2.154E-5	12.783	11.505
1702	39.79	1.6729	1058334	0.0096	426	2.247E-5	13.040	11.736
1726	40.21	1.6828	1058761	0.0096	410	2.338E-5	13.296	11.967
1748	40.60	1.6920	1059147	0.0096	395	2.431E-5	13.564	12.208
1771	41.01	1.7015	1059525	0.0096	377	2.536E-5	13.829	12.446
1795	41.43	1.7112	1059899	0.0095	360	2.644E-5	14.105	12.695
1818	41.85	1.7208	1060257	0.0096	348	2.751E-5	14.387	12.948
1842	42.29	1.7305	1060598	0.0096	334	2.861E-5	14.673	13.205
1867	42.72	1.7400	1060923	0.0096	321	2.978E-5	14.962	13.466
1891	43.15	1.7495	1061233	0.0095	308	3.092E-5	15.257	13.731
1915	43.59	1.7589	1061531	0.0095	295	3.213E-5	15.558	14.002
1941	44.04	1.7686	1061824	0.0095	284	3.351E-5	15.863	14.277
1965	44.49	1.7780	1062103	0.0096	274	3.493E-5	16.178	14.560
1991	44.96	1.7876	1062370	0.0097	263	3.667E-5	16.495	14.846
2017	45.43	1.7972	1062624	0.0096	250	3.845E-5	16.825	15.142
2043	45.92	1.8070	1062878	0.0097	239	4.048E-5	17.163	15.447
2070	46.42	1.8170	1063109	0.0097	228	4.247E-5	17.501	15.751
2096	46.88	1.8262	1063323	0.0097	218	4.451E-5	17.855	16.070
2123	47.39	1.8360	1063536	0.0096	205	4.688E-5	18.205	16.385
2151	47.90	1.8457	1063739	0.0096	195	4.923E-5	18.571	16.713
2179	48.42	1.8554	1063933	0.0097	187	5.189E-5	18.936	17.042
2206	48.92	1.8648	1064105	0.0097	178	5.451E-5	19.312	17.380
2234	49.44	1.8743	1064276	0.0097	168	5.746E-5	19.697	17.727
2263	50.00	1.8844	1064447	0.0097	159	6.082E-5	20.085	18.076
2292	50.54	1.8940	1064601	0.0097	151	6.422E-5	20.492	18.442
2321	51.09	1.9036	1064747	0.0096	143	6.794E-5	20.899	18.809
2350	51.65	1.9134	1064886	0.0096	134	7.192E-5	21.307	19.176
2379	52.20	1.9228	1065011	0.0096	127	7.592E-5	21.727	19.554
2408	52.76	1.9322	1065132	0.0096	119	8.071E-5	22.150	19.935
2438	53.34	1.9419	1065250	0.0195	230	8.487E-5	22.586	20.327
2469	53.94	1.9517	1065362	0.0196	212	9.237E-5	23.035	20.731

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
	54.55	1.9615	1065462					
	55.20	1.9719	1065576					
2450	55.75	1.9804	1065678	0.0181	212	8.538E-5	23.373	21.036
2450	56.37	1.9900	1065788	0.0195	220	8.858E-5	23.537	21.183
2450	57.02	1.9999	1065898	0.0196	216	9.059E-5	23.712	21.341
2450	57.66	2.0096	1066004	0.0097	104	9.258E-5	23.891	21.502
2450	58.32	2.0192	1066105	0.0098	102	9.495E-5	24.071	21.664
2450	58.98	2.0289	1066207	0.0098	100	9.728E-5	24.253	21.827
2450	59.65	2.0385	1066304	0.0098	98	9.924E-5	24.440	21.996
2450	60.36	2.0486	1066402	0.0098	96	1.011E-4	24.629	22.166
2450	61.08	2.0585	1066500	0.0098	94	1.034E-4	24.822	22.339
2450	61.79	2.0681	1066593	0.0098	92	1.055E-4	25.015	22.514
2450	62.50	2.0778	1066683	0.0097	90	1.079E-4	25.212	22.690
2450	63.25	2.0877	1066772	0.0097	87	1.107E-4	25.408	22.867
2450	63.99	2.0973	1066858	0.0097	85	1.137E-4	25.610	23.049
2450	64.74	2.1070	1066943	0.0097	83	1.165E-4	25.812	23.230
2450	65.51	2.1167	1067024	0.0097	81	1.197E-4	26.018	23.416
2450	66.29	2.1265	1067104	0.0098	79	1.238E-4	26.225	23.602
2450	67.08	2.1361	1067182	0.0097	76	1.281E-4	26.438	23.794
2450	67.89	2.1459	1067256	0.0097	73	1.322E-4	26.656	23.990
2450	68.75	2.1561	1067331	0.0097	71	1.366E-4	26.872	24.184
2450	69.56	2.1655	1067398	0.0098	69	1.411E-4	27.094	24.384
2450	70.38	2.1749	1067464	0.0091	63	1.456E-4	27.315	24.583
2450	71.25	2.1847	1067531	0.0077	52	1.517E-4	27.542	24.787
2450	72.16	2.1948	1067596	0.0064	42	1.433E-4	27.628	24.765
2432	72.69	2.2007	1067632	0.0052	33	1.401E-4	27.847	25.045
2447	72.82	2.2021	1067640	0.0034	20	1.711E-4	27.859	24.971
2450	72.99	2.2041	1067652	0.0040	24	1.647E-4	27.983	25.168
2450	73.17	2.2061	1067664	0.1146	509	2.252E-4	0.000	0.000
2450	84.23	2.3187	1068161	0.1216	527	2.308E-4	0.000	0.000
2450	85.21	2.3277	1068191	0.0190	63	3.015E-4	31.301	28.170
2450	86.33	2.3377	1068224	0.0200	66	3.035E-4	31.578	28.419
2450	87.46	2.3477	1068257	0.0202	64	3.159E-4	31.880	28.692
2450	88.64	2.3579	1068288	0.0102	32	3.212E-4	32.195	28.975
2450	89.91	2.3687	1068321	0.0102	31	3.315E-4	32.510	29.258
2450	91.13	2.3788	1068352	0.0102	29	3.460E-4	32.834	29.549
2450	92.34	2.3887	1068380	0.0102	28	3.601E-4	33.155	29.838
2450	93.58	2.3987	1068407	0.0101	27	3.769E-4	33.479	30.129
2450	94.87	2.4088	1068432	0.0102	26	3.933E-4	33.815	30.431
2450	96.21	2.4191	1068458	0.0103	25	4.114E-4	34.159	30.740
2450	97.59	2.4295	1068483	0.0103	24	4.328E-4	34.511	31.057
2450	98.98	2.4398	1068507	0.0104	23	4.614E-4	34.876	31.385
2450	100.44	2.4503	1068529	0.0103	22	4.854E-4	35.240	31.712
2450	101.88	2.4606	1068549	0.0103	21	5.071E-4	35.622	32.055
2449	103.43	2.4713	1068568	0.0104	19	5.334E-4	35.986	32.383

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Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK	
2450	104.83	2.4808	1068587	0.0102	18	5.626E-4	36.381	32.737	
2449	106.40	2.4914	1068606	0.0102	17	5.999E-4	36.767	33.084	
2449	108.05	2.5021	1068623	0.0101	16	6.495E-4	37.156	33.433	
2449	109.57	2.5118	1068637	0.0102	15	6.934E-4	37.564	33.799	*
2449	111.16	2.5217	1068651	0.0103	14	7.435E-4	37.966	34.160	*
2449	112.86	2.5321	1068664	0.0101	13	7.969E-4	38.375	34.527	*
2449	114.54	2.5422	1068677	0.0102	12	8.574E-4	38.809	34.914	*
2448	116.36	2.5529	1068689	0.0103	11	9.184E-4	39.234	35.295	*
2448	118.10	2.5628	1068699	0.0105	11	9.759E-4	39.681	35.693	*
2448	119.92	2.5730	1068709	0.0102	10	1.028E-3	40.130	36.096	*
2448	121.83	2.5835	1068719	0.0102	9	1.086E-3	40.593	36.501	*
2445	123.98	2.5950	1068729	0.0103	9	1.169E-3	41.037	36.905	*
2446	125.61	2.6035	1068737	0.0103	8	1.254E-3	41.538	37.342	*
2447	127.69	2.6141	1068745	0.0102	8	1.331E-3	41.993	37.753	*
2446	129.80	2.6247	1068752	0.0101	7	1.450E-3	42.514	38.220	*
2446	131.94	2.6351	1068759	0.0104	7	1.608E-3	42.992	38.638	*
2444	134.01	2.6450	1068766	0.0103	6	1.765E-3	43.511	39.096	*
2443	136.26	2.6555	1068771	0.0104	6	1.944E-3	44.021	39.546	*
2443	138.60	2.6661	1068776	0.0106	5	2.272E-3	44.531	39.986	*
2441	140.87	2.6761	1068781	0.0107	4	2.669E-3	45.043	40.424	*
2434	143.35	2.6868	1068785	0.0105	4	3.189E-3	45.532	40.821	*
2425	146.13	2.6985	1068788	0.0222	6	3.695E-3	46.002	41.185	*
2419	148.68	2.7090	1068791	0.0200	5	3.994E-3	46.399	41.471	*
	151.06	2.7185	1068793						

Automated Fatigue Crack
Growth Rate Analysis

Test ID	5083-FCG-4pt5	Geometry	C(T)
Contract	SSC 10624-01	Orientation	T-L
Material	5083-H321	Yield (ksi)	34.3
Temperature (F)	75	Modulus (Msi)	10.5
Environment	Sea Water		

Specimen Dimensions (in)

Thickness	0.499	Height	2.400
Net Thickness	0.499	Notch Depth	1.000
Width	4.000	Gage Length	0.500

Precrack Parameters

Pmax (lbs)	784.0	Stress Ratio	0.10
Final a (in)	1.050	Kmax (ksi sqr[in])	4.00

Test Parameters

EvBP	Freq	Pmax	R	Ai	Kmaxi	C	DKi
24.520	0.50	0	0.10	1.195	2.70	4.00	0.00
32.540	0.50	0	0.10	1.491	8.80	2.00	0.00
55.204	0.50	2450	0.10	0.000	0.00	0.00	0.00

K Coeff	C Coeff
.886	1.00098
4.64	-4.66951
-13.32	18.4601
14.72	-236.825
-5.6	1214.88
.	-2143.57

Visual Observations

EvB/P	Crack(EvB/P)	Crack(visual)	Error	CAF
20.869	1.012	1.000	-0.012	1.013
21.842	1.062	1.065	0.003	1.010
23.217	1.127	1.125	-0.002	1.006
24.253	1.174	1.170	-0.004	1.004
24.439	1.182	1.195	0.013	1.003
28.306	1.335	1.350	0.015	0.995
32.493	1.475	1.480	0.005	0.987
34.530	1.535	1.530	-0.005	0.984
36.488	1.589	1.580	-0.009	0.982
46.151	1.812	1.805	-0.007	0.970
54.785	1.965	1.955	-0.010	0.962
72.549	2.199	2.210	0.011	0.951

Comments

Date of test: 9/10/2006

Waveform Type Sine

Test ID 5083-FCG-4pt5 Page 1

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
	28.48	1.3413	998455					
806	28.53	1.3430	1000171	0.0037	3556	1.051E-6	4.981	4.483
812	28.59	1.3450	1002011	0.0038	3513	1.088E-6	5.019	4.517
817	28.64	1.3469	1003684	0.0019	1632	1.178E-6	5.061	4.555
823	28.70	1.3489	1005309	0.0019	1565	1.241E-6	5.101	4.591
829	28.75	1.3508	1006809	0.0019	1477	1.294E-6	5.143	4.629
834	28.81	1.3528	1008246	0.0019	1427	1.338E-6	5.184	4.665
840	28.86	1.3546	1009559	0.0019	1375	1.371E-6	5.224	4.702
845	28.91	1.3564	1010871	0.0019	1344	1.398E-6	5.266	4.739
851	28.96	1.3583	1012246	0.0019	1313	1.438E-6	5.307	4.776
857	29.02	1.3603	1013559	0.0019	1270	1.487E-6	5.349	4.814
862	29.07	1.3621	1014871	0.0019	1226	1.549E-6	5.394	4.854
869	29.13	1.3642	1016121	0.0019	1171	1.629E-6	5.436	4.892
874	29.18	1.3660	1017181	0.0019	1127	1.674E-6	5.480	4.932
880	29.23	1.3678	1018227	0.0019	1082	1.750E-6	5.523	4.971
886	29.29	1.3697	1019273	0.0019	1040	1.798E-6	5.564	5.008
891	29.34	1.3715	1020318	0.0019	1013	1.861E-6	5.612	5.050
898	29.40	1.3736	1021364	0.0019	978	1.934E-6	5.654	5.088
904	29.45	1.3754	1022360	0.0019	951	2.009E-6	5.702	5.132
910	29.51	1.3774	1023256	0.0019	911	2.090E-6	5.746	5.171
916	29.56	1.3792	1024096	0.0019	871	2.149E-6	5.792	5.213
922	29.62	1.3811	1024980	0.0019	844	2.237E-6	5.837	5.253
928	29.67	1.3829	1025782	0.0019	823	2.290E-6	5.884	5.295
935	29.72	1.3848	1026592	0.0039	1642	2.381E-6	5.932	5.339
942	29.78	1.3868	1027424	0.0039	1600	2.451E-6	5.979	5.381
948	29.84	1.3887	1028192	0.0895	18520	4.831E-6	0.000	0.000
1293	32.54	1.4763	1045944	0.0890	17884	4.979E-6	0.000	0.000
1296	32.59	1.4778	1046076	0.0032	293	1.107E-5	0.000	0.000
1299	32.65	1.4796	1046237	0.0038	333	1.146E-5	8.760	7.884
1303	32.72	1.4816	1046409	0.0039	337	1.167E-5	8.793	7.914
1306	32.78	1.4835	1046574	0.0035	317	1.112E-5	8.826	7.944
1309	32.83	1.4851	1046726	0.0019	165	1.147E-5	8.863	7.976
1313	32.90	1.4872	1046904	0.0019	163	1.149E-5	8.898	8.008
1317	32.97	1.4894	1047083	0.0019	163	1.169E-5	8.931	8.038
1320	33.02	1.4909	1047228	0.0019	162	1.183E-5	8.970	8.073
1324	33.09	1.4928	1047386	0.0019	159	1.190E-5	9.003	8.102
1327	33.16	1.4949	1047551	0.0019	156	1.215E-5	9.037	8.134
1331	33.22	1.4967	1047697	0.0019	156	1.230E-5	9.074	8.167
1334	33.28	1.4985	1047855	0.0019	153	1.239E-5	9.111	8.200
1338	33.35	1.5007	1048021	0.0019	151	1.250E-5	9.146	8.231
1342	33.41	1.5025	1048166	0.0019	153	1.249E-5	9.183	8.264
1345	33.47	1.5043	1048305	0.0019	150	1.269E-5	9.218	8.297
1349	33.54	1.5062	1048457	0.0019	146	1.285E-5	9.253	8.328
1353	33.60	1.5081	1048615	0.0019	148	1.287E-5	9.291	8.362

Test ID 5083-FCG-4pt5 Page 2

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
1356	33.67	1.5101	1048754	0.0019	150	1.281E-5	9.328	8.395
1360	33.73	1.5120	1048895	0.0019	147	1.285E-5	9.364	8.428
1364	33.79	1.5138	1049055	0.0019	143	1.312E-5	9.402	8.462
1367	33.86	1.5158	1049207	0.0019	144	1.318E-5	9.437	8.493
1371	33.92	1.5176	1049339	0.0019	142	1.347E-5	9.476	8.529
1375	33.99	1.5196	1049475	0.0019	136	1.396E-5	9.512	8.561
1378	34.05	1.5215	1049617	0.0019	133	1.431E-5	9.551	8.596
1382	34.12	1.5234	1049744	0.0019	134	1.423E-5	9.588	8.629
1386	34.19	1.5252	1049871	0.0019	134	1.427E-5	9.626	8.664
1390	34.25	1.5272	1050003	0.0019	131	1.451E-5	9.662	8.696
1393	34.31	1.5289	1050140	0.0038	275	1.386E-5	9.703	8.732
1397	34.39	1.5310	1050278	0.0040	260	1.549E-5	9.740	8.766
1401	34.45	1.5330	1050400	0.6731	17374	3.874E-5	0.000	0.000
2450	72.99	2.2041	1067652	0.6731	17264	3.899E-5	0.000	0.000
2450	73.17	2.2061	1067664	0.0040	24	1.662E-4	0.000	0.000
2450	73.35	2.2081	1067676	0.0043	24	1.784E-4	28.101	25.291
2450	73.55	2.2104	1067688	0.0041	22	1.872E-4	28.148	25.333
2450	73.72	2.2122	1067698	0.0039	22	1.792E-4	28.201	25.380
2450	73.90	2.2143	1067710	0.0021	11	1.832E-4	28.250	25.425
2450	74.09	2.2164	1067721	0.0020	11	1.836E-4	28.299	25.469
2450	74.27	2.2184	1067732	0.0020	11	1.828E-4	28.351	25.516
2450	74.46	2.2204	1067743	0.0020	11	1.841E-4	28.401	25.561
2450	74.65	2.2226	1067755	0.0020	11	1.832E-4	28.451	25.606
2450	74.83	2.2245	1067765	0.0020	11	1.833E-4	28.502	25.652
2450	75.01	2.2265	1067776	0.0021	11	1.854E-4	28.552	25.697
2450	75.21	2.2286	1067788	0.0020	11	1.873E-4	28.602	25.742
2450	75.39	2.2305	1067798	0.0021	11	1.863E-4	28.655	25.789
2450	75.60	2.2328	1067809	0.0021	11	1.877E-4	28.706	25.836
2450	75.79	2.2348	1067821	0.0020	11	1.900E-4	28.761	25.884
2450	75.98	2.2369	1067832	0.0021	11	1.932E-4	28.812	25.931
2450	76.17	2.2389	1067842	0.0020	10	1.976E-4	28.864	25.978
2450	76.35	2.2409	1067852	0.0021	10	2.053E-4	28.915	26.023
2450	76.55	2.2429	1067861	0.0020	10	2.092E-4	28.966	26.069
2450	76.74	2.2450	1067871	0.0020	10	2.138E-4	29.020	26.118
2450	76.95	2.2471	1067881	0.0021	9	2.189E-4	29.071	26.164
2450	77.13	2.2491	1067890	0.0021	9	2.215E-4	29.126	26.213
2450	77.33	2.2511	1067899	0.0020	9	2.264E-4	29.179	26.261
2450	77.53	2.2532	1067908	0.0020	9	2.299E-4	29.232	26.308
2450	77.74	2.2553	1067917	0.0040	17	2.345E-4	29.285	26.356
2450	77.92	2.2572	1067925	0.0039	17	2.319E-4	29.338	26.404
	78.12	2.2593	1067934					

Automated Fatigue Crack
Growth Rate Analysis

Test ID	5083-FCG-4pt05	Geometry	C(T)
Contract	SSC 10624-01	Orientation	T-L
Material	5083-H321	Yield (ksi)	34.3
Temperature (F)	75	Modulus (Msi)	10.5
Environment	Sea Water		

Specimen Dimensions (in)

Thickness	0.499	Height	2.400
Net Thickness	0.499	Notch Depth	1.000
Width	4.000	Gage Length	0.500

Precrack Parameters

Pmax (lbs)	784.0	Stress Ratio	0.10
Final a (in)	1.050	Kmax (ksi sqr[in])	4.00

Test Parameters

EvBP	Freq	Pmax	R	Ai	Kmaxi	C	DKi
32.540	0.05	0	0.10	1.491	8.80	2.00	0.00
55.200	0.05	2450	0.10	0.000	0.00	0.00	0.00

K Coeff	C Coeff
.886	1.00098
4.64	-4.66951
-13.32	18.4601
14.72	-236.825
-5.6	1214.88
.	-2143.57

Visual Observations

EvB/P	Crack(EvB/P)	Crack(visual)	Error	CAF
20.869	1.012	1.000	-0.012	1.013
21.842	1.062	1.065	0.003	1.010
23.217	1.127	1.125	-0.002	1.006
24.253	1.174	1.170	-0.004	1.004
24.439	1.182	1.195	0.013	1.003
28.306	1.335	1.350	0.015	0.995
32.493	1.475	1.480	0.005	0.987
34.530	1.535	1.530	-0.005	0.984
36.488	1.589	1.580	-0.009	0.982
46.151	1.812	1.805	-0.007	0.970
54.785	1.965	1.955	-0.010	0.962
72.549	2.199	2.210	0.011	0.951

Comments

Date of test: 9/11/2006
Waveform Type Sine

Test ID 5083-FCG-4pt05 Page 1

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
	34.57	1.5362	1050529					
1412	34.64	1.5383	1050642	0.0043	232	1.844E-5	9.890	8.901
1416	34.72	1.5405	1050761	0.0041	240	1.702E-5	9.932	8.939
1420	34.79	1.5424	1050882	0.0020	132	1.588E-5	9.973	8.976
1424	34.85	1.5442	1051008	0.0020	140	1.460E-5	10.011	9.010
1427	34.91	1.5461	1051155	0.0019	145	1.338E-5	10.051	9.046
1431	34.99	1.5481	1051322	0.0019	149	1.277E-5	10.091	9.082
1435	35.06	1.5501	1051481	0.0039	310	1.247E-5	10.132	9.118
1439	35.12	1.5520	1051632	0.0038	297	1.290E-5	10.173	9.156
1443	35.20	1.5540	1051778	0.7117	16317	4.362E-5	0.000	0.000
2450	78.55	2.2636	1067949	0.7113	16179	4.396E-5	0.000	0.000
2450	78.71	2.2653	1067957	0.0039	17	2.278E-4	29.553	26.596
2450	78.93	2.2675	1067966	0.0041	18	2.268E-4	29.602	26.642
2450	79.11	2.2693	1067975	0.0040	17	2.349E-4	29.661	26.694
2450	79.32	2.2715	1067983	0.0021	8	2.461E-4	29.711	26.741
2450	79.53	2.2735	1067992	0.0020	8	2.490E-4	29.769	26.792
2450	79.73	2.2756	1067999	0.0021	8	2.548E-4	29.825	26.842
2450	79.94	2.2777	1068007	0.0021	8	2.624E-4	29.878	26.891
2450	80.15	2.2797	1068016	0.0021	8	2.536E-4	29.938	26.943
2450	80.37	2.2819	1068024	0.0021	8	2.503E-4	29.991	26.993
2450	80.58	2.2839	1068033	0.0021	8	2.582E-4	30.050	27.045
2450	80.79	2.2860	1068041	0.0021	8	2.671E-4	30.107	27.096
2450	81.00	2.2880	1068048	0.0020	8	2.676E-4	30.162	27.146
2450	81.21	2.2901	1068055	0.0020	8	2.730E-4	30.221	27.198
2450	81.43	2.2923	1068063	0.0020	8	2.719E-4	30.273	27.245
2450	81.61	2.2940	1068070	0.0020	8	2.680E-4	30.330	27.297
2450	81.83	2.2961	1068078	0.0020	8	2.679E-4	30.386	27.347
2450	82.05	2.2982	1068086	0.0020	8	2.709E-4	30.442	27.398
2450	82.26	2.3002	1068093	0.0021	8	2.757E-4	30.499	27.449
2450	82.47	2.3022	1068100	0.0021	8	2.769E-4	30.558	27.502
2450	82.69	2.3043	1068108	0.0020	7	2.775E-4	30.615	27.552
2450	82.92	2.3065	1068115	0.0042	15	2.772E-4	30.672	27.606
2450	83.13	2.3085	1068123	0.0040	15	2.669E-4	30.732	27.657
	83.34	2.3105	1068130					

Automated Fatigue Crack
Growth Rate Analysis

Test ID	5083-FCG-4Cpt05	Gecometry	C(T)
Contract	SSC 10624-01	Orientation	T-L
Material	5083-H321	Yield (ksi)	34.3
Temperature (F)	75	Modulus (Msi)	10.5
Environment	Sea Water		

Specimen Dimensions (in)

Thickness	0.499	Height	2.400
Net Thickness	0.499	Notch Depth	1.000
Width	4.000	Gage Length	0.500

Precrack Parameters

Pmax (lbs)	784.0	Stress Ratio	0.10
Final a (in)	1.050	Kmax (ksi sqr[in])	4.00

Test Parameters

EvBP	Freq	Pmax	R	Ai	Kmaxi	C	DKi
32.540	0.05	0	0.10	1.491	8.80	2.00	0.00

K Coeff	C Coeff
.886	1.00098
4.64	-4.66951
-13.32	18.4601
14.72	-236.825
-5.6	1214.88
.	-2143.57

Visual Observations

EvB/P	Crack(EvB/P)	Crack(visual)	Error	CAF
20.869	1.012	1.000	-0.012	1.013
21.842	1.062	1.065	0.003	1.010
23.217	1.127	1.125	-0.002	1.006
24.253	1.174	1.170	-0.004	1.004
24.439	1.182	1.195	0.013	1.003
28.306	1.335	1.350	0.015	0.995
32.493	1.475	1.480	0.005	0.987
34.530	1.535	1.530	-0.005	0.984
36.488	1.589	1.580	-0.009	0.982
46.151	1.812	1.805	-0.007	0.970
54.785	1.965	1.955	-0.010	0.962
72.549	2.199	2.210	0.011	0.951

Comments

Date of test: 9/11/2006
Waveform Type Sine

Test ID 5083-FCG-4Cpt05 Page 1

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
	35.27	1.5561	1052018					
1450	35.32	1.5574	1052093	0.0033	193	1.702E-5	10.294	9.264
1454	35.39	1.5594	1052211	0.0039	239	1.636E-5	10.330	9.297
1458	35.46	1.5613	1052332	0.0018	108	1.733E-5	10.372	9.335
1463	35.54	1.5634	1052446	0.0019	113	1.699E-5	10.415	9.373
1467	35.61	1.5654	1052559	0.0019	110	1.717E-5	10.455	9.410
1470	35.67	1.5672	1052668	0.0019	108	1.746E-5	10.496	9.447
1474	35.74	1.5689	1052772	0.0019	107	1.754E-5	10.536	9.482
1478	35.81	1.5708	1052872	0.0019	107	1.762E-5	10.577	9.519
1482	35.88	1.5728	1052981	0.0019	105	1.785E-5	10.618	9.556
1486	35.95	1.5747	1053090	0.0019	104	1.792E-5	10.660	9.594
1490	36.02	1.5766	1053198	0.0019	105	1.810E-5	10.701	9.631
1494	36.08	1.5784	1053298	0.0019	105	1.825E-5	10.742	9.668
1498	36.15	1.5802	1053394	0.0019	104	1.849E-5	10.786	9.707
1502	36.23	1.5823	1053503	0.0019	104	1.864E-5	10.827	9.744
1506	36.30	1.5842	1053611	0.0039	213	1.820E-5	10.873	9.786
1510	36.37	1.5862	1053716	0.0039	209	1.850E-5	10.916	9.824
	36.44	1.5881	1053820					

Automated Fatigue Crack
Growth Rate Analysis

Test ID	5083-FCG-5	Geometry	C(T)
Contract	SSC 10624-01	Orientation	T-L
Material	5083-H321	Yield (ksi)	34.3
Temperature (F)	75	Modulus (Msi)	10.5
Environment	RH = 40%		

Specimen Dimensions (in)

Thickness	0.501	Height	2.400
Net Thickness	0.501	Notch Depth	1.000
Width	4.000	Gage Length	0.500

Precrack Parameters

Pmax (lbs)	970.0	Stress Ratio	0.10
Final a (in)	1.070	Kmax (ksi sqr[in])	5.00

Test Parameters

EvBP	Freq	Pmax	R	Ai	Kmaxi	C	DKi
22.377	24.00	0	0.10	1.070	5.00	-4.00	0.00
25.814	24.00	0	0.10	1.220	3.00	4.00	0.00

K Coeff	C Coeff	da/dN Fit Parameters (DKapp)	
.886	1.00098	Upper da/dN limit	3.937E-8
4.64	-4.66951	Lower da/dN limit	3.937E-9
-13.32	18.4601	da/dN intercept (C)	4.703E-19
14.72	-236.825	da/dN slope (m)	23.534
-5.6	1214.88	da/dN for delta K	3.937E-9
.	-2143.57	delta K	2.640

Visual Observations

EvB/P	Crack(EvB/P)	Crack(visual)	Error	CAF
20.596	0.986	1.002	0.016	1.004
22.230	1.095	1.085	-0.010	1.022
23.182	1.153	1.130	-0.023	1.031
25.135	1.263	1.280	0.017	1.050
29.099	1.377	1.380	0.003	1.007
33.040	1.491	1.485	-0.006	0.986
36.200	1.571	1.575	0.004	0.972

Comments

Date of test: 9/15/2006
Waveform Type Sine

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
	22.38	1.1041	10728					
915	22.47	1.1100	23029	0.0121	27551	4.410E-7	4.839	4.355
893	22.57	1.1163	38279	0.0123	32016	3.831E-7	4.750	4.275
873	22.67	1.1222	55045	0.0061	18007	3.736E-7	4.656	4.190
852	22.77	1.1286	75113	0.0061	19963	3.249E-7	4.568	4.111
832	22.88	1.1348	96589	0.0060	22076	2.914E-7	4.481	4.033
814	22.97	1.1406	118770	0.0061	24696	2.664E-7	4.396	3.957
796	23.07	1.1464	142808	0.0061	26807	2.441E-7	4.316	3.884
778	23.17	1.1523	170733	0.0061	28683	2.229E-7	4.232	3.809
759	23.28	1.1589	203223	0.0061	30846	2.046E-7	4.151	3.736
741	23.38	1.1652	235954	0.0061	32699	1.905E-7	4.069	3.662
724	23.49	1.1712	268687	0.0061	34308	1.810E-7	3.990	3.591
707	23.59	1.1772	303843	0.0061	35864	1.732E-7	3.914	3.523
691	23.69	1.1831	339000	0.0059	38490	1.643E-7	3.840	3.456
676	23.79	1.1891	376581	0.0061	41052	1.551E-7	3.767	3.390
660	23.90	1.1952	418404	0.0060	43715	1.453E-7	3.697	3.327
646	24.00	1.2008	466891	0.0060	50006	1.350E-7	3.622	3.260
629	24.12	1.2078	514999	0.0060	59226	1.248E-7	3.556	3.201
615	24.22	1.2134	566135	0.0058	69269	1.118E-7	3.484	3.136
601	24.33	1.2193	639038	0.0056	78447	9.119E-8	3.419	3.077
587	24.44	1.2254	731939	0.0050	87071	6.515E-8	3.359	3.023
576	24.53	1.2302	834016	0.0045	95189	4.837E-8	3.305	2.975
568	24.60	1.2341	937571	0.0039	99681	3.802E-8	3.260	2.934
560	24.66	1.2376	1037427	0.0032	100841	3.077E-8	3.226	2.904
554	24.71	1.2401	1137270	0.0027	100470	2.639E-8	3.194	2.875
549	24.75	1.2425	1237125	0.0025	99854	2.368E-8	3.173	2.856
546	24.78	1.2443	1336982	0.0022	99852	2.176E-8	3.149	2.834
541	24.83	1.2466	1436838	0.0020	99854	2.047E-8	3.129	2.816
536	24.87	1.2488	1536694	0.0017	99854	1.844E-8	3.108	2.797
532	24.90	1.2507	1636537	0.0016	99854	1.620E-8	3.089	2.780
529	24.93	1.2522	1736391	0.0014	99854	1.348E-8	3.074	2.767
527	24.94	1.2530	1836248	0.0012	99852	1.136E-8	3.063	2.756
525	24.96	1.2539	1936105	0.0010	99854	9.715E-9	3.053	2.747
523	24.98	1.2550	2035961	0.0008	99854	8.715E-9	3.044	2.739
521	25.00	1.2560	2135807	0.0008	99854	8.383E-9	3.034	2.731
520	25.01	1.2566	2235659	0.0008	99854	8.113E-9	3.027	2.724
519	25.02	1.2573	2335516	0.0008	99853	7.915E-9	3.019	2.717
517	25.04	1.2581	2435373	0.0008	99853	7.876E-9	3.012	2.711
515	25.06	1.2590	2535229	0.0008	99854	7.890E-9	3.004	2.704
513	25.07	1.2599	2635076	0.0007	99854	7.276E-9	2.996	2.697
512	25.09	1.2606	2734926	0.0006	99854	5.927E-9	2.989	2.690
511	25.10	1.2611	2834782	0.0004	99853	4.154E-9	2.984	2.685
510	25.10	1.2615	2934639	0.0003	99853	2.475E-9	2.981	2.683
	25.10	1.2615	3034496					

Test ID 5083-FCG-5 Page 2

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
510	25.10	1.2615	3134345	-0.0001	199697	-4.017E-10	2.977	2.680
510	25.10	1.2615	3234193	0.0395	-1938770	-2.037E-8	0.000	0.000
674	27.12	1.3010	1195575	0.0444	-2015140	-2.204E-8	0.000	0.000
685	27.24	1.3059	1219053	0.0094	48927	1.915E-7	4.117	3.706
696	27.36	1.3104	1244502	0.0098	48475	2.027E-7	4.202	3.781
709	27.49	1.3157	1267528	0.0099	41447	2.400E-7	4.281	3.853
720	27.61	1.3203	1285949	0.0049	19014	2.689E-7	4.368	3.931
732	27.73	1.3251	1303205	0.0050	17151	2.972E-7	4.454	4.009
744	27.86	1.3302	1318713	0.0049	15278	3.288E-7	4.541	4.087
757	27.98	1.3350	1333137	0.0050	13697	3.702E-7	4.635	4.171
770	28.11	1.3402	1347407	0.0050	12211	4.295E-7	4.728	4.255
783	28.25	1.3454	1359195	0.0051	10885	5.102E-7	4.823	4.340
795	28.37	1.3501	1368130	0.0051	9434	5.970E-7	4.923	4.431
810	28.51	1.3552	1376473	0.0050	7861	6.949E-7	5.026	4.523
825	28.66	1.3609	1384022	0.0049	6683	7.959E-7	5.128	4.616
838	28.78	1.3657	1389742	0.0049	5941	8.682E-7	5.232	4.709
851	28.90	1.3702	1394570	0.0048	5194	9.459E-7	5.335	4.802
865	29.03	1.3749	1399295	0.0046	4512	1.024E-6	5.433	4.890
879	29.16	1.3793	1403773	0.0044	4073	1.109E-6	5.546	4.992
895	29.31	1.3840	1407636	0.0044	3751	1.204E-6	5.654	5.088
911	29.45	1.3882	1411091	0.0043	3397	1.314E-6	5.770	5.193
926	29.58	1.3924	1414180	0.0043	3037	1.428E-6	5.888	5.299
943	29.73	1.3967	1417074	0.0042	2740	1.563E-6	6.003	5.403
959	29.87	1.4010	1419676	0.0042	2473	1.724E-6	6.122	5.509
974	30.00	1.4049	1421993	0.0042	2264	1.891E-6	6.242	5.618
991	30.14	1.4092	1424076	0.0041	2060	2.057E-6	6.361	5.725
1007	30.28	1.4132	1425930	0.0041	1863	2.252E-6	6.486	5.838
1024	30.42	1.4175	1427764	0.0042	1711	2.471E-6	6.610	5.949
1041	30.56	1.4216	1429431	0.0042	1588	2.704E-6	6.741	6.067
1059	30.70	1.4257	1430851	0.0043	1459	2.970E-6	6.873	6.186
1077	30.85	1.4300	1432260	0.0042	1319	3.252E-6	7.012	6.311
1096	31.00	1.4345	1433602	0.0042	1212	3.537E-6	7.153	6.438
1115	31.15	1.4388	1434685	0.0042	1132	3.789E-6	7.291	6.562
1132	31.28	1.4425	1435677	0.0042	1039	4.081E-6	7.437	6.693
1152	31.43	1.4468	1436702	0.0042	944	4.424E-6	7.577	6.819
1171	31.58	1.4511	1437641	0.0042	889	4.767E-6	7.729	6.956
1191	31.74	1.4554	1438494	0.0042	850	5.068E-6	7.878	7.090
1211	31.89	1.4595	1439263	0.0042	789	5.380E-6	8.039	7.235
1232	32.04	1.4638	1440019	0.0042	735	5.695E-6	8.193	7.374
1253	32.19	1.4680	1440779	0.0042	688	6.085E-6	8.357	7.522
1274	32.34	1.4722	1441436	0.0042	652	6.474E-6	8.518	7.666
1295	32.49	1.4762	1442048	0.0042	613	6.983E-6	8.686	7.818
1317	32.65	1.4805	1442624	0.0084	1126	7.480E-6	8.851	7.966
1338	32.80	1.4846	1443174	0.0086	1071	8.070E-6	9.033	8.130
	32.97	1.4892	1443695					

Test ID 5083-FCG-5 Page 3

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK

Automated Fatigue Crack
Growth Rate Analysis

Test ID	5086-FCG-1	Geometry	C(T)
Contract	SSC 10624-01	Orientation	T-L
Material	5086-H116	Yield (ksi)	27.0
Temperature (F)	75	Modulus (Msi)	10.5
Environment	RH = 40%		

Specimen Dimensions (in)

Thickness	0.496	Height	2.400
Net Thickness	0.496	Notch Depth	1.000
Width	4.000	Gage Length	0.500

Precrack Parameters

Pmax (lbs)	779.0	Stress Ratio	0.10
Final a (in)	1.050	Kmax (ksi sqr[in])	4.00

Test Parameters

EvBP	Freq	Pmax	R	Ai	Kmaxi	C	DKi
22.978	10.00	0	0.10	1.100	3.20	4.00	0.00
29.766	10.00	0	0.10	1.396	10.42	2.00	0.00
47.942	5.00	2975	0.10	0.000	0.00	0.00	0.00

K Coeff	C Coeff
.886	1.00098
4.64	-4.66951
-13.32	18.4601
14.72	-236.825
-5.6	1214.88
.	-2143.57

Visual Observations

EvB/P	Crack(EvB/P)	Crack(visual)	Error	CAF
20.484	0.989	1.001	0.013	1.011
21.438	1.038	1.035	-0.003	1.009
21.843	1.059	1.055	-0.004	1.007
22.920	1.110	1.115	0.005	1.005
24.869	1.197	1.195	-0.002	1.000
26.312	1.256	1.255	-0.001	0.997
27.456	1.301	1.295	-0.006	0.994
29.780	1.384	1.380	-0.004	0.990
39.990	1.675	1.665	-0.010	0.975
47.607	1.838	1.850	0.012	0.967

Comments

Date of test: 8/16/2006
Waveform Type Sine

Test ID 5086-FCG-1 Page 1

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
	23.06	1.1171	66929					
639	23.17	1.1219	119196	0.0095	102819	9.261E-8	3.441	3.097
650	23.27	1.1267	169748	0.0095	97833	9.739E-8	3.510	3.159
661	23.37	1.1314	217029	0.0048	46026	1.035E-7	3.580	3.222
672	23.48	1.1360	260146	0.0047	43374	1.097E-7	3.652	3.286
683	23.58	1.1408	302605	0.0047	40604	1.166E-7	3.724	3.352
695	23.69	1.1457	343082	0.0047	38177	1.245E-7	3.799	3.419
707	23.79	1.1504	379439	0.0048	36445	1.322E-7	3.875	3.487
718	23.90	1.1550	413372	0.0048	34216	1.401E-7	3.953	3.558
731	24.01	1.1598	446093	0.0047	31913	1.478E-7	4.033	3.630
744	24.12	1.1648	478814	0.0047	30297	1.563E-7	4.114	3.702
756	24.23	1.1694	507899	0.0048	28681	1.666E-7	4.196	3.777
768	24.33	1.1739	534561	0.0048	26662	1.789E-7	4.280	3.852
781	24.44	1.1787	561222	0.0047	24440	1.943E-7	4.365	3.929
795	24.55	1.1837	585460	0.0047	22501	2.132E-7	4.453	4.008
808	24.66	1.1883	606062	0.0047	20642	2.345E-7	4.542	4.088
821	24.77	1.1929	625453	0.0047	18525	2.600E-7	4.632	4.169
835	24.88	1.1976	642904	0.0047	16553	2.898E-7	4.723	4.251
849	24.99	1.2022	658414	0.0047	14981	3.249E-7	4.817	4.335
863	25.10	1.2069	672371	0.0047	13404	3.662E-7	4.914	4.422
878	25.21	1.2117	684779	0.0048	12067	4.094E-7	5.011	4.510
893	25.33	1.2164	695946	0.0048	10823	4.558E-7	5.115	4.603
909	25.44	1.2213	705875	0.0047	9675	5.053E-7	5.218	4.696
924	25.56	1.2262	715306	0.0047	8719	5.608E-7	5.325	4.792
940	25.68	1.2308	723351	0.0047	7863	6.164E-7	5.431	4.888
956	25.79	1.2354	730421	0.0047	7108	6.811E-7	5.540	4.986
972	25.91	1.2401	737090	0.0047	6341	7.605E-7	5.648	5.083
988	26.02	1.2447	743124	0.0047	5686	8.554E-7	5.762	5.186
1005	26.14	1.2496	748523	0.0047	5111	9.653E-7	5.877	5.290
1022	26.26	1.2544	753350	0.0047	4542	1.090E-6	5.996	5.397
1040	26.38	1.2591	757468	0.0047	4040	1.216E-6	6.118	5.506
1057	26.50	1.2637	761087	0.0047	3639	1.337E-6	6.237	5.613
1074	26.62	1.2684	764339	0.0047	3268	1.471E-6	6.361	5.725
1092	26.74	1.2730	767363	0.0047	2933	1.623E-6	6.489	5.840
1112	26.86	1.2779	770355	0.0047	2653	1.816E-6	6.620	5.958
1131	26.99	1.2828	772957	0.0047	2416	2.034E-6	6.751	6.076
1149	27.11	1.2873	775065	0.0047	2190	2.246E-6	6.888	6.199
1168	27.23	1.2919	777003	0.0047	1955	2.480E-6	7.022	6.320
1188	27.35	1.2967	778836	0.0047	1758	2.737E-6	7.161	6.445
1208	27.48	1.3013	780503	0.0048	1608	3.011E-6	7.307	6.577
1229	27.61	1.3063	782086	0.0048	1472	3.322E-6	7.456	6.710
1251	27.74	1.3112	783507	0.0048	1345	3.664E-6	7.605	6.845
1271	27.86	1.3158	784714	0.0048	1225	3.995E-6	7.762	6.986
1293	27.99	1.3205	785837	0.0047	1111	4.310E-6	7.916	7.125

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
1316	28.12	1.3254	786904	0.0047	1016	4.642E-6	8.074	7.267
1337	28.25	1.3300	787854	0.0047	950	4.961E-6	8.234	7.411
1359	28.37	1.3345	788750	0.0047	890	5.306E-6	8.396	7.556
1382	28.50	1.3392	789604	0.0047	828	5.691E-6	8.560	7.704
1405	28.64	1.3439	790415	0.0047	772	6.124E-6	8.733	7.860
1430	28.77	1.3488	791179	0.0047	727	6.564E-6	8.907	8.017
1454	28.90	1.3535	791870	0.0047	686	6.980E-6	9.086	8.177
1478	29.03	1.3581	792483	0.0048	647	7.371E-6	9.268	8.341
1503	29.17	1.3628	793114	0.0048	611	7.831E-6	9.452	8.507
1529	29.31	1.3676	793718	0.0048	573	8.304E-6	9.644	8.679
1555	29.44	1.3725	794294	0.0099	1125	8.837E-6	9.844	8.860
1583	29.59	1.3776	794843	0.0096	1014	9.505E-6	10.040	9.036
	29.72	1.3821	795308					
	29.77	1.3836	795836					
1627	29.88	1.3875	796251	0.0105	1074	9.792E-6	10.425	9.382
1643	30.08	1.3941	796910	0.0158	1558	1.014E-5	10.568	9.511
1664	30.35	1.4033	797809	0.0189	1803	1.048E-5	10.747	9.672
1687	30.64	1.4130	798713	0.0090	816	1.106E-5	10.958	9.862
1710	30.94	1.4228	799594	0.0095	827	1.150E-5	11.176	10.059
1734	31.23	1.4323	800388	0.0095	793	1.202E-5	11.400	10.260
1757	31.53	1.4417	801149	0.0095	757	1.258E-5	11.623	10.461
1781	31.82	1.4511	801874	0.0095	720	1.318E-5	11.851	10.666
1804	32.12	1.4604	802565	0.0095	690	1.372E-5	12.086	10.877
1829	32.43	1.4701	803256	0.0095	663	1.432E-5	12.327	11.094
1855	32.75	1.4799	803913	0.0095	639	1.492E-5	12.572	11.314
1880	33.05	1.4891	804526	0.0096	615	1.552E-5	12.827	11.545
1906	33.37	1.4988	805129	0.0095	587	1.621E-5	13.078	11.770
1931	33.69	1.5082	805706	0.0095	562	1.686E-5	13.340	12.006
1957	34.02	1.5178	806254	0.0096	540	1.765E-5	13.604	12.243
1984	34.35	1.5273	806776	0.0095	516	1.847E-5	13.873	12.486
2011	34.67	1.5367	807285	0.0096	493	1.942E-5	14.152	12.736
2039	35.02	1.5465	807766	0.0095	467	2.039E-5	14.432	12.989
2066	35.36	1.5560	808224	0.0095	445	2.146E-5	14.724	13.251
2094	35.71	1.5657	808661	0.0096	422	2.264E-5	15.011	13.510
2122	36.05	1.5748	809054	0.0095	398	2.384E-5	15.311	13.780
2150	36.40	1.5844	809445	0.0095	377	2.520E-5	15.610	14.049
2179	36.76	1.5940	809818	0.0095	357	2.671E-5	15.918	14.326
2208	37.12	1.6034	810156	0.0095	339	2.820E-5	16.236	14.613
2238	37.49	1.6130	810487	0.0095	321	2.971E-5	16.558	14.903
2269	37.87	1.6227	810800	0.0095	306	3.123E-5	16.882	15.194
2298	38.23	1.6319	811085	0.0097	295	3.271E-5	17.217	15.495
2328	38.60	1.6414	811369	0.0097	280	3.438E-5	17.559	15.803
2360	39.01	1.6513	811654	0.0096	263	3.642E-5	17.913	16.122
2393	39.42	1.6614	811924	0.0096	251	3.857E-5	18.277	16.449
2425	39.81	1.6709	812164	0.0097	239	4.088E-5	18.644	16.780

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
2457	40.21	1.6803	812379	0.0096	223	4.303E-5	19.009	17.108
2488	40.59	1.6894	812590	0.0095	209	4.540E-5	19.389	17.451
2522	41.02	1.6994	812800	0.0095	198	4.801E-5	19.759	17.783
2554	41.42	1.7086	812992	0.0096	189	5.068E-5	20.159	18.143
2588	41.85	1.7183	813175	0.0096	180	5.363E-5	20.551	18.496
2622	42.28	1.7280	813349	0.0095	168	5.673E-5	20.965	18.869
2658	42.72	1.7377	813515	0.0096	160	6.010E-5	21.376	19.239
2692	43.15	1.7471	813668	0.0096	152	6.337E-5	21.800	19.620
2726	43.58	1.7564	813809	0.0096	144	6.649E-5	22.229	20.006
2762	44.04	1.7661	813950	0.0096	137	7.005E-5	22.665	20.399
2798	44.50	1.7758	814084	0.0097	130	7.413E-5	23.114	20.803
2834	44.96	1.7853	814212	0.0097	124	7.824E-5	23.577	21.220
2871	45.44	1.7951	814334	0.0097	118	8.238E-5	24.053	21.648
2910	45.94	1.8053	814450	0.0096	112	8.678E-5	24.531	22.078
2947	46.42	1.8147	814555	0.0188	207	9.063E-5	25.022	22.521
2984	46.89	1.8240	814657	0.0189	199	9.509E-5	25.511	22.960
	47.39	1.8336	814754					
	47.94	1.8445	814876					
2975	48.38	1.8532	814967	0.0188	194	9.695E-5	25.976	23.378
2975	48.90	1.8633	815070	0.0202	205	9.839E-5	26.152	23.537
2975	49.42	1.8734	815172	0.0205	208	9.868E-5	26.347	23.712
2975	49.98	1.8838	815278	0.0101	103	9.856E-5	26.545	23.890
2975	50.54	1.8943	815383	0.0101	102	9.900E-5	26.743	24.069
2975	51.08	1.9043	815485	0.0101	101	9.977E-5	26.942	24.248
2975	51.61	1.9140	815583	0.0101	100	1.008E-4	27.142	24.427
2975	52.17	1.9241	815680	0.0100	98	1.022E-4	27.341	24.607
2975	52.75	1.9342	815778	0.0100	96	1.040E-4	27.546	24.792
2975	53.33	1.9443	815875	0.0101	96	1.057E-4	27.755	24.980
2975	53.91	1.9543	815969	0.0101	94	1.073E-4	27.966	25.169
2975	54.51	1.9644	816062	0.0101	93	1.091E-4	28.182	25.364
2975	55.14	1.9748	816156	0.0102	92	1.111E-4	28.399	25.559
2975	55.75	1.9849	816245	0.0102	90	1.126E-4	28.622	25.760
2975	56.38	1.9951	816335	0.0102	89	1.144E-4	28.846	25.961
2975	57.03	2.0053	816424	0.0102	87	1.164E-4	29.072	26.165
2975	57.67	2.0154	816510	0.0102	86	1.186E-4	29.303	26.372
2975	58.34	2.0256	816595	0.0101	83	1.214E-4	29.537	26.583
2975	59.02	2.0360	816680	0.0101	81	1.245E-4	29.772	26.795
2975	59.69	2.0461	816758	0.0101	79	1.277E-4	30.010	27.009
2975	60.36	2.0559	816834	0.0101	76	1.313E-4	30.249	27.224
2975	61.06	2.0660	816910	0.0101	74	1.355E-4	30.489	27.440
2975	61.77	2.0761	816983	0.0101	72	1.397E-4	30.734	27.660
2975	62.48	2.0860	817053	0.0101	70	1.448E-4	30.989	27.889
2975	63.23	2.0964	817124	0.0102	67	1.513E-4	31.242	28.117
2975	63.98	2.1066	817190	0.0102	65	1.576E-4	31.503	28.352
2975	64.73	2.1167	817252	0.0102	63	1.634E-4	31.768	28.591

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Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK	
2975	65.52	2.1270	817312	0.0102	60	1.694E-4	32.033	28.829	
2975	66.31	2.1372	817371	0.0102	58	1.758E-4	32.303	29.072	
2975	67.09	2.1472	817428	0.0102	56	1.826E-4	32.582	29.323	*
2975	67.93	2.1577	817485	0.0102	54	1.885E-4	32.855	29.569	*
2975	68.74	2.1677	817535	0.0102	52	1.954E-4	33.146	29.831	*
2975	69.61	2.1781	817586	0.0102	50	2.049E-4	33.427	30.084	*
2975	70.44	2.1880	817637	0.0101	46	2.184E-4	33.725	30.352	*
2975	71.33	2.1984	817684	0.0101	44	2.328E-4	34.015	30.613	*
2975	72.21	2.2085	817725	0.0100	41	2.481E-4	34.310	30.878	*
2975	73.06	2.2181	817760	0.0101	38	2.638E-4	34.610	31.148	*
2975	73.96	2.2281	817798	0.0100	36	2.771E-4	34.907	31.415	*
2975	74.88	2.2381	817833	0.0101	35	2.878E-4	35.222	31.699	*
2975	75.85	2.2485	817867	0.0102	34	3.001E-4	35.536	31.982	*
2975	76.81	2.2587	817902	0.0102	32	3.184E-4	35.868	32.280	*
2975	77.82	2.2691	817935	0.0101	30	3.382E-4	36.197	32.576	*
2975	78.84	2.2794	817963	0.0101	28	3.657E-4	36.529	32.874	*
2975	79.82	2.2892	817989	0.0102	26	3.999E-4	36.860	33.171	*
2975	80.81	2.2988	818014	0.0101	23	4.380E-4	37.203	33.481	*
2975	81.90	2.3094	818036	0.0101	22	4.763E-4	37.549	33.791	*
2975	83.01	2.3199	818057	0.0102	20	5.209E-4	37.902	34.107	*
2975	84.06	2.3296	818075	0.0102	18	5.681E-4	38.273	34.442	*
2975	85.21	2.3400	818093	0.0101	17	6.235E-4	38.630	34.762	*
2974	86.35	2.3502	818109	0.0100	15	6.847E-4	39.008	35.102	*
2974	87.51	2.3603	818123	0.0101	14	7.532E-4	39.371	35.428	*
2974	88.61	2.3698	818135	0.0101	13	8.124E-4	39.752	35.769	*
2974	89.81	2.3800	818147	0.0102	12	8.799E-4	40.137	36.117	*
2974	91.07	2.3904	818158	0.0106	11	9.708E-4	40.531	36.467	*
2974	92.35	2.4007	818169	0.0103	10	1.072E-3	40.948	36.844	*
2973	93.69	2.4114	818179	0.0104	9	1.228E-3	41.405	37.245	*
2973	95.29	2.4238	818188	0.0105	8	1.521E-3	41.715	37.519	*
2964	96.28	2.4313	818194	0.0109	6	1.970E-3	42.203	37.944	*
2964	97.75	2.4424	818200	0.0110	5	2.460E-3	42.543	38.241	*
2965	99.26	2.4534	818204	0.0239	7	3.416E-3	42.984	38.616	*
2954	101.07	2.4663	818207	0.0239	7	3.419E-3	43.391	38.960	*
	102.64	2.4773	818211						

Automated Fatigue Crack
Growth Rate Analysis

Test ID	5086-FCG-2	Geometry	C(T)
Contract	SSC 10624-01	Orientation	T-L
Material	5086-H116	Yield (ksi)	27.0
Temperature (F)	75	Modulus (Msi)	10.5
Environment	RH = 40%		

Specimen Dimensions (in)

Thickness	0.496	Height	2.400
Net Thickness	0.496	Notch Depth	1.000
Width	4.000	Gage Length	0.500

Precrack Parameters

Pmax (lbs)	779.0	Stress Ratio	0.10
Final a (in)	1.050	Kmax (ksi sqr[in])	4.00

Test Parameters

EvBP	Freq	Pmax	R	Ai	Kmaxi	C	DKi
23.356	10.00	0	0.10	1.130	3.00	4.00	0.00
31.296	10.00	0	0.10	1.446	10.60	2.00	0.00
49.484	5.00	2840	0.10	0.000	0.00	0.00	0.00

K Coeff	C Coeff
.886	1.00098
4.64	-4.66951
-13.32	18.4601
14.72	-236.825
-5.6	1214.88
.	-2143.57

Visual Observations

EvB/P	Crack(EvB/P)	Crack(visual)	Error	CAF
20.433	0.988	1.001	0.013	1.013
21.842	1.061	1.060	-0.001	1.009
23.496	1.139	1.135	-0.004	1.005
27.422	1.302	1.300	-0.002	0.997
31.212	1.434	1.430	-0.004	0.990
41.599	1.716	1.710	-0.006	0.976
49.143	1.870	1.870	0.000	0.968
103.926	2.466	2.470	0.004	0.939

Comments

Date of test: 8/21/2006
Waveform Type Sine

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Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
	23.36	1.1330	49863					
558	23.46	1.1378	135356	0.0089	154118	5.807E-8	3.031	2.728
566	23.55	1.1419	203981	0.0088	139929	6.284E-8	3.092	2.783
576	23.66	1.1466	275285	0.0048	68985	6.983E-8	3.153	2.838
586	23.77	1.1518	345898	0.0048	64956	7.576E-8	3.215	2.894
596	23.88	1.1565	403283	0.0050	63113	7.933E-8	3.285	2.957
607	23.99	1.1616	463772	0.0050	59559	8.343E-8	3.354	3.019
618	24.11	1.1669	525094	0.0049	55679	8.730E-8	3.424	3.082
629	24.22	1.1716	582657	0.0050	53373	9.266E-8	3.497	3.147
639	24.33	1.1765	632641	0.0049	49918	9.866E-8	3.566	3.209
650	24.44	1.1812	679974	0.0048	46008	1.058E-7	3.641	3.277
662	24.56	1.1863	723519	0.0047	42284	1.130E-7	3.712	3.341
673	24.66	1.1908	763279	0.0047	40012	1.187E-7	3.788	3.410
684	24.77	1.1955	801144	0.0047	37930	1.247E-7	3.862	3.476
695	24.88	1.2000	836361	0.0047	35722	1.300E-7	3.939	3.545
707	24.99	1.2048	872715	0.0047	33791	1.380E-7	4.018	3.616
719	25.11	1.2097	907554	0.0048	32126	1.485E-7	4.096	3.687
731	25.21	1.2142	937848	0.0048	30296	1.605E-7	4.180	3.762
743	25.33	1.2190	966024	0.0047	27670	1.734E-7	4.265	3.839
757	25.45	1.2241	993897	0.0046	25096	1.885E-7	4.351	3.916
770	25.57	1.2288	1018135	0.0047	23440	2.042E-7	4.437	3.994
782	25.67	1.2331	1038737	0.0048	21653	2.222E-7	4.523	4.071
794	25.78	1.2375	1058127	0.0047	19430	2.446E-7	4.613	4.152
808	25.90	1.2426	1078487	0.0048	17588	2.773E-7	4.704	4.233
822	26.03	1.2476	1095939	0.0048	15989	3.137E-7	4.803	4.323
837	26.15	1.2524	1110479	0.0047	14433	3.475E-7	4.902	4.412
851	26.27	1.2573	1123661	0.0046	12513	3.842E-7	4.999	4.499
865	26.38	1.2617	1134673	0.0046	11061	4.287E-7	5.095	4.586
878	26.49	1.2659	1144724	0.0047	9962	4.813E-7	5.191	4.672
892	26.60	1.2702	1153563	0.0046	8838	5.366E-7	5.294	4.765
908	26.73	1.2754	1162305	0.0046	7945	6.083E-7	5.400	4.860
925	26.86	1.2805	1170252	0.0048	7201	6.878E-7	5.509	4.958
939	26.98	1.2849	1176687	0.0049	6575	7.713E-7	5.622	5.059
955	27.09	1.2895	1182340	0.0049	5737	8.771E-7	5.734	5.161
972	27.23	1.2945	1187929	0.0047	5002	9.908E-7	5.852	5.267
990	27.36	1.2997	1193010	0.0048	4526	1.108E-6	5.974	5.376
1007	27.49	1.3045	1196725	0.0048	4131	1.199E-6	6.093	5.483
1022	27.60	1.3087	1200264	0.0048	3677	1.311E-6	6.216	5.594
1040	27.73	1.3135	1203842	0.0046	3229	1.443E-6	6.336	5.703
1058	27.86	1.3182	1207126	0.0047	3026	1.599E-6	6.464	5.817
1076	27.99	1.3232	1209988	0.0048	2784	1.781E-6	6.593	5.933
1093	28.11	1.3276	1212383	0.0047	2483	1.960E-6	6.729	6.056
1113	28.25	1.3327	1214883	0.0047	2213	2.193E-6	6.861	6.175
1132	28.38	1.3374	1216966	0.0047	2014	2.405E-6	6.998	6.298

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
1149	28.50	1.3418	1218737	0.0049	1851	2.685E-6	7.138	6.424
1169	28.63	1.3466	1220404	0.0047	1632	2.975E-6	7.276	6.549
1189	28.77	1.3514	1222071	0.0047	1483	3.272E-6	7.431	6.688
1211	28.92	1.3568	1223487	0.0048	1366	3.580E-6	7.576	6.819
1231	29.04	1.3611	1224674	0.0048	1253	3.874E-6	7.733	6.960
1251	29.17	1.3656	1225864	0.0048	1139	4.201E-6	7.885	7.097
1272	29.31	1.3705	1226932	0.0047	1053	4.530E-6	8.038	7.234
1294	29.44	1.3751	1227924	0.0048	983	4.928E-6	8.205	7.385
1317	29.59	1.3801	1228906	0.0047	905	5.286E-6	8.372	7.535
1340	29.73	1.3851	1229802	0.0047	848	5.649E-6	8.542	7.688
1362	29.87	1.3898	1230570	0.0048	798	6.025E-6	8.707	7.837
1383	29.99	1.3939	1231292	0.0047	743	6.375E-6	8.883	7.995
1407	30.14	1.3989	1232017	0.0047	696	6.713E-6	9.055	8.150
1432	30.28	1.4038	1232709	0.0046	660	7.085E-6	9.236	8.312
1455	30.42	1.4085	1233365	0.0047	628	7.477E-6	9.425	8.483
1480	30.56	1.4131	1233978	0.0047	602	7.883E-6	9.606	8.645
1503	30.70	1.4177	1234527	0.0048	574	8.342E-6	9.795	8.815
1528	30.83	1.4221	1235058	0.0097	1099	8.808E-6	9.996	8.996
1556	30.99	1.4273	1235626	0.0104	1092	9.484E-6	10.199	9.179
	31.15	1.4325	1236150					
	31.30	1.4372	1236656					
1618	31.51	1.4440	1237333	0.0166	1602	1.036E-5	10.746	9.671
1640	31.82	1.4538	1238258	0.0191	1806	1.057E-5	10.930	9.837
1662	32.11	1.4631	1239139	0.0186	1711	1.087E-5	11.145	10.031
1683	32.41	1.4724	1239969	0.0096	819	1.170E-5	11.371	10.234
1708	32.74	1.4825	1240798	0.0095	780	1.230E-5	11.595	10.435
1731	33.06	1.4923	1241558	0.0096	743	1.294E-5	11.831	10.648
1755	33.37	1.5016	1242249	0.0096	707	1.356E-5	12.065	10.859
1778	33.69	1.5110	1242940	0.0095	665	1.423E-5	12.304	11.073
1802	34.01	1.5206	1243597	0.0095	634	1.491E-5	12.546	11.292
1827	34.34	1.5300	1244209	0.0095	610	1.564E-5	12.793	11.513
1851	34.67	1.5394	1244786	0.0095	580	1.636E-5	13.048	11.743
1876	35.01	1.5490	1245362	0.0095	558	1.708E-5	13.308	11.977
1902	35.36	1.5588	1245911	0.0095	536	1.777E-5	13.569	12.212
1927	35.69	1.5679	1246420	0.0095	513	1.851E-5	13.846	12.462
1954	36.05	1.5778	1246944	0.0095	490	1.944E-5	14.116	12.704
1980	36.40	1.5873	1247425	0.0095	467	2.045E-5	14.396	12.957
2006	36.75	1.5966	1247862	0.0096	445	2.158E-5	14.683	13.215
2033	37.11	1.6063	1248299	0.0096	420	2.285E-5	14.971	13.474
2060	37.49	1.6160	1248714	0.0096	399	2.407E-5	15.270	13.743
2088	37.86	1.6254	1249089	0.0096	379	2.530E-5	15.579	14.021
2117	38.24	1.6352	1249462	0.0095	358	2.654E-5	15.886	14.298
2145	38.62	1.6447	1249818	0.0096	341	2.800E-5	16.202	14.582
2173	38.99	1.6540	1250134	0.0096	328	2.933E-5	16.515	14.863
2201	39.37	1.6632	1250447	0.0096	311	3.091E-5	16.851	15.166

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
2232	39.79	1.6734	1250760	0.0096	294	3.264E-5	17.182	15.464
2262	40.20	1.6832	1251059	0.0096	280	3.437E-5	17.535	15.782
2292	40.61	1.6929	1251329	0.0097	266	3.642E-5	17.885	16.097
2322	41.01	1.7022	1251580	0.0096	251	3.849E-5	18.234	16.411
2352	41.41	1.7115	1251815	0.0096	237	4.070E-5	18.595	16.736
2383	41.85	1.7212	1252042	0.0096	224	4.291E-5	18.962	17.066
2415	42.28	1.7311	1252265	0.0096	212	4.524E-5	19.344	17.410
2447	42.73	1.7409	1252478	0.0096	202	4.757E-5	19.732	17.759
2479	43.16	1.7503	1252670	0.0096	192	5.022E-5	20.122	18.110
2511	43.60	1.7597	1252853	0.0097	181	5.337E-5	20.514	18.463
2543	44.04	1.7691	1253027	0.0096	170	5.657E-5	20.924	18.832
2577	44.51	1.7790	1253193	0.0096	161	6.015E-5	21.342	19.208
2612	44.99	1.7891	1253353	0.0096	151	6.409E-5	21.766	19.590
2645	45.45	1.7984	1253498	0.0097	143	6.808E-5	22.209	19.988
2679	45.93	1.8080	1253633	0.0096	134	7.165E-5	22.640	20.376
2714	46.41	1.8176	1253761	0.0095	126	7.550E-5	23.090	20.781
2749	46.90	1.8272	1253883	0.0096	120	7.974E-5	23.535	21.182
2782	47.37	1.8364	1253999	0.0096	113	8.427E-5	24.001	21.601
2818	47.87	1.8460	1254110	0.0194	218	8.922E-5	24.471	22.024
2855	48.40	1.8559	1254217	0.0195	203	9.599E-5	24.953	22.458
	48.91	1.8655	1254313					
	49.48	1.8760	1254424					
2840	49.97	1.8847	1254526	0.0184	213	8.662E-5	25.363	22.827
2840	50.51	1.8944	1254637	0.0193	217	8.887E-5	25.533	22.979
2840	51.05	1.9040	1254743	0.0193	209	9.225E-5	25.715	23.144
2840	51.61	1.9137	1254846	0.0097	104	9.313E-5	25.900	23.310
2840	52.19	1.9236	1254948	0.0096	101	9.494E-5	26.086	23.478
2840	52.77	1.9333	1255051	0.0097	99	9.694E-5	26.274	23.647
2840	53.33	1.9427	1255149	0.0097	98	9.885E-5	26.463	23.816
2840	53.91	1.9522	1255243	0.0097	96	1.009E-4	26.655	23.990
2840	54.53	1.9621	1255338	0.0097	93	1.039E-4	26.850	24.165
2840	55.14	1.9719	1255432	0.0097	91	1.068E-4	27.050	24.345
2840	55.76	1.9816	1255522	0.0098	90	1.092E-4	27.251	24.526
2840	56.39	1.9913	1255608	0.0097	87	1.113E-4	27.455	24.709
2840	57.03	2.0011	1255694	0.0097	85	1.142E-4	27.662	24.896
2840	57.69	2.0110	1255780	0.0097	83	1.166E-4	27.868	25.081
2840	58.33	2.0204	1255862	0.0097	81	1.193E-4	28.082	25.274
2840	59.00	2.0303	1255940	0.0097	79	1.227E-4	28.288	25.459
2840	59.65	2.0396	1256017	0.0097	76	1.265E-4	28.508	25.657
2840	60.36	2.0495	1256094	0.0097	74	1.307E-4	28.726	25.853
2840	61.07	2.0595	1256168	0.0097	73	1.340E-4	28.948	26.053
2840	61.77	2.0690	1256238	0.0098	72	1.372E-4	29.175	26.257
2840	62.49	2.0787	1256306	0.0098	70	1.401E-4	29.402	26.461
2840	63.23	2.0886	1256376	0.0098	67	1.438E-4	29.637	26.673
2840	64.00	2.0986	1256448	0.0098	65	1.492E-4	29.870	26.883

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK	
2840	64.75	2.1083	1256511	0.0099	64	1.553E-4	30.113	27.101	
2840	65.52	2.1180	1256571	0.0098	61	1.616E-4	30.350	27.314	
2840	66.29	2.1276	1256628	0.0097	58	1.688E-4	30.603	27.542	
2840	67.14	2.1380	1256688	0.0098	55	1.765E-4	30.841	27.757	
2840	67.90	2.1472	1256741	0.0097	53	1.836E-4	31.102	27.991	
2840	68.73	2.1571	1256793	0.0098	52	1.901E-4	31.349	28.214	
2840	69.57	2.1668	1256841	0.0097	50	1.967E-4	31.601	28.440	
2840	70.37	2.1760	1256886	0.0097	48	2.017E-4	31.868	28.680	
2840	71.27	2.1861	1256937	0.0097	47	2.058E-4	32.130	28.916	
2840	72.17	2.1962	1256985	0.0098	46	2.098E-4	32.400	29.159	*
2840	73.04	2.2056	1257030	0.0099	45	2.171E-4	32.680	29.411	*
2840	73.96	2.2155	1257076	0.0098	43	2.274E-4	32.953	29.657	*
2840	74.89	2.2253	1257118	0.0097	41	2.386E-4	33.239	29.915	*
2840	75.85	2.2353	1257157	0.0098	39	2.508E-4	33.523	30.170	*
2840	76.79	2.2449	1257195	0.0099	37	2.673E-4	33.816	30.434	*
2840	77.77	2.2547	1257231	0.0099	35	2.830E-4	34.111	30.699	*
2840	78.78	2.2646	1257266	0.0099	33	2.992E-4	34.421	30.978	*
2840	79.87	2.2752	1257298	0.0099	32	3.142E-4	34.721	31.247	*
2840	80.85	2.2845	1257327	0.0099	30	3.275E-4	35.046	31.540	*
2840	81.94	2.2946	1257357	0.0098	29	3.408E-4	35.349	31.812	*
2840	82.98	2.3041	1257385	0.0098	27	3.564E-4	35.677	32.107	*
2840	84.10	2.3142	1257413	0.0099	26	3.815E-4	35.991	32.390	*
2840	85.17	2.3237	1257438	0.0098	24	4.116E-4	36.327	32.692	*
2840	86.32	2.3337	1257461	0.0099	23	4.476E-4	36.656	32.989	*
2840	87.49	2.3436	1257482	0.0100	21	4.849E-4	37.002	33.299	*
2840	88.68	2.3536	1257502	0.0099	20	5.150E-4	37.350	33.612	*
2840	89.89	2.3635	1257520	0.0099	18	5.440E-4	37.715	33.941	*
2840	91.19	2.3740	1257538	0.0098	17	5.778E-4	38.061	34.251	*
2839	92.36	2.3832	1257555	0.0098	16	6.087E-4	38.432	34.584	*
2839	93.61	2.3929	1257570	0.0098	15	6.389E-4	38.787	34.904	*
2839	94.90	2.4026	1257584	0.0097	14	6.857E-4	39.160	35.238	*
2839	96.23	2.4126	1257599	0.0098	13	7.498E-4	39.533	35.573	*
2839	97.54	2.4221	1257612	0.0099	12	8.137E-4	39.924	35.923	*
2838	98.95	2.4322	1257623	0.0098	11	8.917E-4	40.317	36.277	*
2839	100.38	2.4423	1257634	0.0103	11	9.812E-4	40.716	36.633	*
2838	101.81	2.4521	1257644	0.0101	10	1.055E-3	41.118	36.994	*
2838	103.19	2.4614	1257652	0.0102	9	1.150E-3	41.594	37.418	*
2837	105.14	2.4746	1257663	0.0105	8	1.442E-3	41.890	37.671	*
2828	106.32	2.4825	1257670	0.0107	7	1.894E-3	42.358	38.078	*
2821	107.95	2.4932	1257676	0.0109	6	2.505E-3	42.725	38.392	*
2821	109.84	2.5053	1257680	0.0103	4	2.960E-3	43.172	38.778	*
2822	111.60	2.5163	1257683	0.0215	6	3.584E-3	43.668	39.215	*
2819	113.31	2.5268	1257686	0.0202	6	3.370E-3	44.020	39.503	*
	114.94	2.5365	1257689						

Automated Fatigue Crack
Growth Rate Analysis

Test ID	5086-FCG-3	Geometry	C(T)
Contract	SSC 10624-01	Orientation	T-L
Material	5086-H116	Yield (ksi)	27.0
Temperature (F)	75	Modulus (Msi)	10.5
Environment	Sea Water		

Specimen Dimensions (in)

Thickness	0.496	Height	2.400
Net Thickness	0.496	Notch Depth	1.000
Width	4.001	Gage Length	0.500

Precrack Parameters

Pmax (lbs)	877.0	Stress Ratio	0.10
Final a (in)	1.050	Kmax (ksi sqr[in])	4.50

Test Parameters

EvBP	Freq	Pmax	R	Ai	Kmaxi	C	DKi
24.592	5.00	0	0.10	1.185	2.90	4.00	0.00
32.530	5.00	0	0.10	1.489	9.65	2.00	0.00
53.965	5.00	2630	0.10	0.000	0.00	0.00	0.00

K Coeff	C Coeff
.886	1.00098
4.64	-4.66951
-13.32	18.4601
14.72	-236.825
-5.6	1214.88
.	-2143.57

Visual Observations

EvB/P	Crack(EvB/P)	Crack(visual)	Error	CAF
20.713	1.016	1.002	-0.014	1.024
21.842	1.074	1.050	-0.024	1.021
23.158	1.137	1.150	0.013	1.017
23.897	1.170	1.200	0.030	1.015
28.441	1.352	1.340	-0.012	1.006
32.409	1.484	1.500	0.016	0.999
44.737	1.794	1.790	-0.004	0.982
53.608	1.957	1.950	-0.007	0.974
107.893	2.499	2.500	0.001	0.947

Comments

Date of test: 8/26/2006
Waveform Type Sine

Test ID 5086-FCG-3 Page 1

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
	24.59	1.2004	6238					
521	24.64	1.2024	25700	0.0069	58740	1.173E-7	2.973	2.676
530	24.75	1.2073	64978	0.0098	82088	1.189E-7	3.016	2.714
539	24.87	1.2121	107788	0.0044	34574	1.285E-7	3.078	2.770
548	24.98	1.2169	145913	0.0048	36526	1.316E-7	3.140	2.826
558	25.09	1.2217	177197	0.0048	33598	1.436E-7	3.205	2.884
567	25.21	1.2266	213681	0.0048	30599	1.602E-7	3.267	2.940
576	25.32	1.2312	244856	0.0048	28381	1.739E-7	3.337	3.003
587	25.44	1.2363	266568	0.0048	27206	1.809E-7	3.401	3.061
597	25.56	1.2410	291381	0.0047	25004	1.909E-7	3.472	3.125
607	25.67	1.2457	316197	0.0048	23524	1.984E-7	3.542	3.188
617	25.79	1.2504	340435	0.0047	23461	1.989E-7	3.610	3.249
627	25.90	1.2549	363703	0.0048	22395	2.115E-7	3.684	3.316
638	26.02	1.2598	386002	0.0048	21006	2.281E-7	3.755	3.379
649	26.14	1.2645	407331	0.0047	19422	2.490E-7	3.836	3.452
661	26.27	1.2697	425752	0.0047	17844	2.718E-7	3.911	3.520
672	26.39	1.2742	442231	0.0047	16403	2.926E-7	3.990	3.591
682	26.50	1.2786	456964	0.0047	15019	3.127E-7	4.069	3.662
694	26.62	1.2833	470767	0.0046	14017	3.302E-7	4.146	3.731
705	26.74	1.2879	484417	0.0046	13132	3.533E-7	4.229	3.806
717	26.86	1.2926	497446	0.0047	12331	3.815E-7	4.312	3.881
729	26.98	1.2973	509854	0.0047	11603	4.150E-7	4.398	3.958
742	27.10	1.3021	521022	0.0048	10735	4.554E-7	4.488	4.039
755	27.23	1.3070	530950	0.0048	9888	4.942E-7	4.579	4.121
768	27.36	1.3118	540382	0.0048	9078	5.322E-7	4.674	4.206
781	27.49	1.3166	548824	0.0047	8289	5.714E-7	4.767	4.291
794	27.61	1.3212	556771	0.0047	7703	6.117E-7	4.863	4.377
807	27.73	1.3258	564321	0.0047	7148	6.591E-7	4.957	4.461
820	27.86	1.3303	570755	0.0046	6588	7.085E-7	5.056	4.551
834	27.98	1.3350	577170	0.0047	6152	7.734E-7	5.155	4.639
849	28.11	1.3399	583268	0.0046	5826	8.108E-7	5.256	4.730
862	28.24	1.3443	588349	0.0047	5601	8.475E-7	5.367	4.830
878	28.38	1.3495	593684	0.0048	5251	9.017E-7	5.465	4.919
892	28.50	1.3537	599276	0.0048	4845	9.785E-7	5.584	5.025
907	28.64	1.3588	604359	0.0048	4513	1.093E-6	5.694	5.125
924	28.78	1.3638	608677	0.0047	4106	1.242E-6	5.811	5.230
939	28.91	1.3686	612336	0.0048	3629	1.397E-6	5.930	5.337
955	29.04	1.3731	615425	0.0047	3194	1.532E-6	6.048	5.443
971	29.18	1.3778	618320	0.0047	2861	1.680E-6	6.169	5.553
988	29.31	1.3826	621051	0.0047	2598	1.833E-6	6.290	5.661
1004	29.45	1.3872	623523	0.0047	2406	1.973E-6	6.421	5.779
1022	29.59	1.3921	625840	0.0048	2243	2.139E-6	6.544	5.890
1039	29.72	1.3967	627923	0.0047	2066	2.318E-6	6.675	6.008
1056	29.85	1.4012	629861	0.0047	1890	2.519E-6	6.813	6.131

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
1075	30.00	1.4063	631777	0.0047	1728	2.758E-6	6.946	6.251
1093	30.14	1.4111	633444	0.0047	1593	3.036E-6	7.086	6.378
1110	30.28	1.4155	634865	0.0047	1459	3.315E-6	7.226	6.503
1129	30.41	1.4201	636206	0.0047	1327	3.596E-6	7.369	6.632
1148	30.56	1.4250	637480	0.0047	1218	3.941E-6	7.512	6.761
1167	30.70	1.4296	638617	0.0048	1116	4.325E-6	7.668	6.901
1188	30.85	1.4345	639738	0.0047	1026	4.720E-6	7.823	7.041
1209	31.01	1.4395	640752	0.0047	940	5.166E-6	7.981	7.183
1229	31.15	1.4441	641563	0.0048	866	5.608E-6	8.140	7.326
1249	31.28	1.4485	642361	0.0047	789	6.080E-6	8.303	7.473
1270	31.44	1.4534	643122	0.0047	717	6.584E-6	8.466	7.619
1292	31.59	1.4582	643812	0.0047	673	7.114E-6	8.636	7.773
1313	31.74	1.4629	644469	0.0048	627	7.674E-6	8.811	7.930
1336	31.89	1.4676	645054	0.0047	582	8.176E-6	8.988	8.089
1359	32.04	1.4724	645603	0.0094	1071	8.773E-6	9.165	8.249
1381	32.19	1.4770	646125	0.0093	1009	9.186E-6	9.348	8.413
	32.33	1.4817	646612					
	32.53	1.4877	647008					
1427	32.73	1.4937	647606	0.0151	1479	1.021E-5	9.816	8.835
1445	33.03	1.5028	648487	0.0188	1702	1.107E-5	9.954	8.959
1465	33.35	1.5125	649308	0.0195	1617	1.206E-5	10.150	9.135
1486	33.68	1.5223	650104	0.0095	787	1.208E-5	10.353	9.318
1506	34.01	1.5318	650927	0.0097	754	1.274E-5	10.561	9.505
1526	34.34	1.5413	651668	0.0095	727	1.314E-5	10.773	9.695
1547	34.67	1.5510	652327	0.0095	691	1.373E-5	10.990	9.891
1569	35.02	1.5607	653013	0.0095	654	1.452E-5	11.200	10.080
1588	35.34	1.5695	653671	0.0096	636	1.505E-5	11.426	10.283
1609	35.68	1.5791	654248	0.0096	617	1.548E-5	11.651	10.486
1633	36.05	1.5891	654851	0.0095	588	1.615E-5	11.884	10.695
1655	36.41	1.5988	655482	0.0096	562	1.692E-5	12.126	10.913
1677	36.77	1.6084	656031	0.0096	546	1.750E-5	12.369	11.132
1700	37.13	1.6177	656540	0.0095	526	1.818E-5	12.612	11.351
1722	37.49	1.6271	657043	0.0095	497	1.901E-5	12.860	11.574
1745	37.86	1.6365	657523	0.0095	478	1.975E-5	13.114	11.803
1768	38.23	1.6460	658004	0.0095	466	2.042E-5	13.371	12.034
1792	38.61	1.6555	658463	0.0096	448	2.129E-5	13.641	12.277
1816	39.01	1.6654	658900	0.0095	430	2.213E-5	13.909	12.518
1840	39.40	1.6748	659337	0.0095	412	2.306E-5	14.192	12.773
1865	39.80	1.6846	659730	0.0096	397	2.403E-5	14.466	13.019
1889	40.18	1.6935	660100	0.0095	384	2.489E-5	14.753	13.277
1913	40.58	1.7029	660474	0.0095	364	2.595E-5	15.047	13.543
1940	41.02	1.7130	660847	0.0095	351	2.701E-5	15.343	13.808
1966	41.43	1.7226	661203	0.0096	339	2.838E-5	15.654	14.088
1991	41.84	1.7319	661520	0.0096	324	2.976E-5	15.964	14.367
2018	42.27	1.7415	661833	0.0096	307	3.127E-5	16.281	14.653

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
2045	42.72	1.7512	662132	0.0095	289	3.283E-5	16.603	14.943
2071	43.16	1.7608	662416	0.0096	279	3.430E-5	16.936	15.242
2098	43.60	1.7704	662686	0.0097	267	3.626E-5	17.265	15.538
2125	44.03	1.7795	662937	0.0096	252	3.800E-5	17.613	15.852
2154	44.50	1.7894	663195	0.0096	240	4.014E-5	17.969	16.172
2183	45.01	1.7998	663432	0.0096	228	4.226E-5	18.321	16.488
2210	45.44	1.8086	663643	0.0096	218	4.413E-5	18.699	16.829
2239	45.92	1.8183	663853	0.0095	206	4.610E-5	19.057	17.152
2268	46.40	1.8278	664054	0.0094	197	4.800E-5	19.430	17.487
2296	46.88	1.8371	664246	0.0096	191	5.029E-5	19.811	17.830
2325	47.37	1.8466	664429	0.0096	182	5.279E-5	20.201	18.181
2355	47.89	1.8564	664612	0.0096	173	5.567E-5	20.604	18.544
2386	48.41	1.8663	664786	0.0096	164	5.882E-5	21.024	18.922
2418	48.95	1.8762	664945	0.0096	156	6.207E-5	21.436	19.293
2447	49.44	1.8853	665089	0.0097	147	6.571E-5	21.869	19.682
2478	49.97	1.8948	665231	0.0096	138	6.975E-5	22.288	20.059
2509	50.51	1.9044	665365	0.0096	130	7.371E-5	22.737	20.463
2542	51.08	1.9143	665493	0.0096	125	7.763E-5	23.191	20.872
2575	51.65	1.9242	665615	0.0097	118	8.206E-5	23.650	21.285
2606	52.20	1.9335	665726	0.0189	223	8.491E-5	24.126	21.713
2639	52.77	1.9431	665838	0.0195	214	9.113E-5	24.601	22.140
	53.37	1.9530	665940					
	53.96	1.9627	666037					
2630	54.52	1.9716	666147	0.0188	224	8.411E-5	25.064	22.558
2630	55.15	1.9816	666261	0.0197	219	8.989E-5	25.233	22.710
2630	55.77	1.9913	666366	0.0193	207	9.315E-5	25.422	22.880
2630	56.39	2.0009	666468	0.0097	104	9.339E-5	25.611	23.050
2630	57.02	2.0105	666570	0.0097	102	9.519E-5	25.800	23.220
2630	57.65	2.0199	666667	0.0096	100	9.623E-5	25.995	23.395
2630	58.32	2.0298	666769	0.0096	98	9.778E-5	26.192	23.572
2630	59.01	2.0397	666871	0.0097	97	9.971E-5	26.390	23.750
2630	59.66	2.0490	666964	0.0098	96	1.015E-4	26.594	23.935
2630	60.36	2.0588	667057	0.0097	94	1.038E-4	26.797	24.117
2630	61.07	2.0686	667151	0.0097	90	1.067E-4	27.009	24.308
2630	61.80	2.0787	667245	0.0098	89	1.095E-4	27.219	24.497
2630	62.51	2.0882	667330	0.0097	87	1.120E-4	27.433	24.690
2630	63.23	2.0976	667411	0.0097	84	1.149E-4	27.650	24.885
2630	63.99	2.1076	667497	0.0097	82	1.184E-4	27.865	25.078
2630	64.75	2.1172	667578	0.0097	79	1.213E-4	28.086	25.277
2630	65.49	2.1266	667654	0.0096	78	1.239E-4	28.315	25.483
2630	66.31	2.1367	667734	0.0097	75	1.281E-4	28.537	25.684
2630	67.09	2.1462	667806	0.0097	72	1.333E-4	28.767	25.889
2630	67.86	2.1554	667877	0.0097	70	1.388E-4	29.003	26.103
2630	68.70	2.1655	667947	0.0097	67	1.447E-4	29.236	26.312
2630	69.56	2.1754	668011	0.0098	66	1.500E-4	29.477	26.529

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Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK	
2630	70.38	2.1848	668072	0.0099	64	1.554E-4	29.727	26.754	
2630	71.27	2.1947	668136	0.0098	61	1.600E-4	29.979	26.981	
2630	72.20	2.2051	668200	0.0098	59	1.648E-4	30.235	27.211	
2630	73.10	2.2149	668258	0.0098	58	1.705E-4	30.496	27.447	
2630	74.00	2.2245	668313	0.0098	55	1.773E-4	30.757	27.681	
2630	74.93	2.2342	668367	0.0097	52	1.850E-4	31.016	27.914	
2630	75.85	2.2437	668417	0.0097	50	1.926E-4	31.282	28.153	
2630	76.81	2.2534	668466	0.0097	48	2.004E-4	31.550	28.394	
2630	77.78	2.2631	668513	0.0097	46	2.088E-4	31.825	28.642	*
2630	78.79	2.2729	668559	0.0098	45	2.189E-4	32.103	28.892	*
2630	79.79	2.2826	668603	0.0098	43	2.306E-4	32.389	29.150	*
2630	80.83	2.2924	668645	0.0098	41	2.425E-4	32.683	29.414	*
2630	81.93	2.3027	668685	0.0098	39	2.547E-4	32.976	29.678	*
2630	82.99	2.3123	668721	0.0098	37	2.668E-4	33.276	29.948	*
2630	84.05	2.3218	668756	0.0098	35	2.794E-4	33.582	30.223	*
2630	85.20	2.3319	668792	0.0098	33	2.936E-4	33.883	30.493	*
2630	86.32	2.3415	668824	0.0098	32	3.093E-4	34.203	30.781	*
2630	87.49	2.3514	668855	0.0098	30	3.278E-4	34.523	31.069	*
2630	88.70	2.3615	668885	0.0098	28	3.501E-4	34.848	31.362	*
2630	89.90	2.3713	668912	0.0099	27	3.740E-4	35.170	31.651	*
2630	91.04	2.3804	668936	0.0098	25	3.964E-4	35.513	31.960	*
2630	92.36	2.3908	668961	0.0098	23	4.216E-4	35.841	32.255	*
2630	93.64	2.4007	668983	0.0098	22	4.449E-4	36.189	32.568	*
2630	94.89	2.4101	669004	0.0099	21	4.660E-4	36.544	32.888	*
2630	96.25	2.4202	669025	0.0099	20	4.857E-4	36.901	33.208	*
2630	97.64	2.4303	669045	0.0099	19	5.084E-4	37.259	33.530	*
2630	98.95	2.4396	669063	0.0099	18	5.388E-4	37.645	33.877	*
2630	100.44	2.4501	669083	0.0098	17	5.870E-4	38.008	34.204	*
2630	101.87	2.4598	669099	0.0097	16	6.443E-4	38.396	34.552	*
2630	103.28	2.4693	669113	0.0098	14	7.180E-4	38.775	34.893	*
2629	104.74	2.4789	669126	0.0099	13	7.870E-4	39.165	35.243	*
2629	106.27	2.4887	669138	0.0100	12	8.697E-4	39.555	35.592	*
2630	107.78	2.4983	669148	0.0108	11	1.000E-3	39.991	35.985	*
2629	109.53	2.5095	669160	0.0102	10	1.120E-3	40.402	36.350	*
2628	111.17	2.5197	669169	0.0104	9	1.227E-3	40.961	36.854	*
2630	113.47	2.5338	669177	0.0108	8	1.377E-3	41.283	37.137	*
2626	114.53	2.5401	669184	0.0175	14	1.251E-3	41.844	37.637	*
2623	116.43	2.5513	669191	0.0230	13	1.770E-3	42.190	37.938	*
	118.50	2.5631	669197						

Automated Fatigue Crack
Growth Rate Analysis

Test ID	5086-FCG-45	Geometry	C(T)
Contract	SSC 10624-01	Orientation	T-L
Material	5383-H116	Yield (ksi)	35.4
Temperature (F)	75	Modulus (Msi)	10.5
Environment	RH = 40%		

Specimen Dimensions (in)

Thickness	0.496	Height	2.400
Net Thickness	0.496	Notch Depth	1.000
Width	4.000	Gage Length	0.500

Precrack Parameters

Pmax (lbs)	859.0	Stress Ratio	0.10
Final a (in)	1.050	Kmax (ksi sqr[in])	4.41

Test Parameters

EvBP	Freq	Pmax	R	Ai	Kmaxi	C	DKi
23.716	5.00	0	0.10	1.140	2.80	4.00	0.00
33.922	5.00	0	0.10	1.451	9.69	2.00	0.00
52.247	5.00	2750	0.10	0.000	0.00	0.00	0.00

K Coeff	C Coeff
.886	1.00098
4.64	-4.66951
-13.32	18.4601
14.72	-236.825
-5.6	1214.88
.	-2143.57

Visual Observations

EvB/P	Crack(EvB/P)	Crack(visual)	Error	CAF
20.753	0.983	1.002	0.019	0.993
21.841	1.040	1.040	0.000	0.992
23.480	1.121	1.100	-0.021	0.990
23.760	1.134	1.170	0.036	0.989
26.667	1.260	1.260	0.000	0.987
27.531	1.294	1.280	-0.014	0.986
30.339	1.397	1.380	-0.017	0.983
34.274	1.524	1.490	-0.034	0.981
48.661	1.865	1.880	0.015	0.973
59.300	2.043	2.080	0.037	0.969
66.619	2.142	2.120	-0.022	0.967
101.006	2.462	2.460	-0.002	0.960

Comments

Date of test: 9/9/2006

Waveform Type Sine

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Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
	23.78	1.1354	33353					
535	23.89	1.1402	83477	0.0093	107030	8.711E-8	2.916	2.625
544	23.99	1.1447	140383	0.0099	105802	9.340E-8	2.977	2.680
554	24.10	1.1501	189279	0.0050	45981	1.085E-7	3.037	2.734
564	24.22	1.1554	233480	0.0050	42879	1.212E-7	3.098	2.788
572	24.32	1.1599	277489	0.0050	39050	1.328E-7	3.165	2.849
582	24.44	1.1652	309241	0.0050	35546	1.427E-7	3.227	2.904
593	24.55	1.1701	340750	0.0049	32421	1.535E-7	3.293	2.963
602	24.66	1.1750	374683	0.0049	29126	1.674E-7	3.360	3.024
613	24.77	1.1800	402556	0.0048	27752	1.767E-7	3.425	3.083
622	24.87	1.1846	428006	0.0048	26217	1.880E-7	3.495	3.145
633	24.99	1.1895	452244	0.0050	23955	2.059E-7	3.563	3.207
644	25.10	1.1943	475755	0.0049	22380	2.211E-7	3.634	3.270
654	25.21	1.1991	498053	0.0049	20594	2.426E-7	3.713	3.342
667	25.34	1.2048	518413	0.0048	19165	2.607E-7	3.784	3.406
678	25.45	1.2094	536833	0.0050	17832	2.840E-7	3.866	3.479
689	25.56	1.2142	551568	0.0050	16287	3.041E-7	3.938	3.544
700	25.66	1.2186	567233	0.0049	14858	3.305E-7	4.022	3.620
713	25.79	1.2242	582744	0.0049	13629	3.635E-7	4.098	3.689
725	25.91	1.2288	595772	0.0049	12911	3.919E-7	4.187	3.769
737	26.03	1.2340	607561	0.0049	11872	4.203E-7	4.271	3.844
750	26.15	1.2388	618605	0.0048	10760	4.508E-7	4.356	3.920
762	26.26	1.2436	629031	0.0048	10112	4.779E-7	4.441	3.997
774	26.37	1.2481	638463	0.0048	9538	5.086E-7	4.530	4.077
788	26.49	1.2531	647302	0.0048	8875	5.444E-7	4.616	4.155
800	26.61	1.2578	656441	0.0049	8355	5.857E-7	4.714	4.242
815	26.74	1.2631	664786	0.0050	7894	6.358E-7	4.805	4.325
828	26.85	1.2677	671855	0.0049	7406	6.798E-7	4.907	4.416
843	26.98	1.2727	679160	0.0050	6772	7.370E-7	5.007	4.506
858	27.12	1.2781	685829	0.0048	6101	8.065E-7	5.108	4.597
872	27.23	1.2827	691736	0.0094	11243	8.360E-7	5.212	4.691
886	27.35	1.2875	697072	0.0094	9654	9.755E-7	5.314	4.782
901	27.47	1.2922	701390	0.0390	29392	1.326E-6	0.000	0.000
1014	28.37	1.3265	726464	0.0392	27605	1.418E-6	0.000	0.000
1031	28.50	1.3313	728995	0.0099	4844	2.034E-6	6.358	5.723
1048	28.64	1.3363	731308	0.0099	4387	2.256E-6	6.485	5.836
1066	28.77	1.3412	733382	0.0099	3989	2.477E-6	6.617	5.955
1084	28.90	1.3462	735297	0.0049	1820	2.783E-6	6.748	6.073
1102	29.04	1.3510	736972	0.0049	1657	3.053E-6	6.885	6.196
1121	29.17	1.3559	738453	0.0049	1501	3.346E-6	7.023	6.321
1140	29.31	1.3609	739913	0.0049	1352	3.702E-6	7.166	6.450
1160	29.45	1.3659	741247	0.0049	1233	4.075E-6	7.311	6.580
1179	29.58	1.3708	742390	0.0049	1137	4.436E-6	7.460	6.714
1199	29.72	1.3757	743407	0.0049	1036	4.797E-6	7.607	6.846

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
1219	29.86	1.3805	744372	0.0049	943	5.188E-6	7.760	6.984
1240	29.99	1.3853	745277	0.0049	873	5.596E-6	7.914	7.122
1260	30.13	1.3902	746130	0.0049	817	6.049E-6	8.072	7.265
1281	30.27	1.3950	746903	0.0049	759	6.551E-6	8.235	7.411
1304	30.42	1.4000	747626	0.0049	706	7.078E-6	8.401	7.561
1326	30.56	1.4050	748309	0.0050	656	7.632E-6	8.572	7.715
1348	30.71	1.4099	748927	0.0050	611	8.185E-6	8.748	7.873
1372	30.85	1.4149	749510	0.0049	568	8.750E-6	8.926	8.033
1395	31.00	1.4199	750065	0.0099	1057	9.386E-6	9.106	8.195
1419	31.15	1.4248	750567	0.0097	969	9.969E-6	9.291	8.361
	31.29	1.4295	751034					
	35.34	1.5548	2545					
1744	35.68	1.5642	3058	0.0193	1039	1.858E-5	12.504	11.253
1767	36.03	1.5741	3584	0.0197	1040	1.889E-5	12.749	11.474
1791	36.38	1.5839	4098	0.0199	1004	1.981E-5	13.006	11.706
1815	36.74	1.5939	4588	0.0099	482	2.060E-5	13.266	11.939
1840	37.11	1.6038	5054	0.0099	463	2.143E-5	13.533	12.180
1864	37.48	1.6137	5507	0.0099	441	2.235E-5	13.809	12.428
1890	37.86	1.6239	5951	0.0098	423	2.323E-5	14.084	12.675
1915	38.24	1.6337	6364	0.0098	406	2.419E-5	14.367	12.930
1940	38.61	1.6433	6746	0.0098	389	2.521E-5	14.651	13.186
1965	38.99	1.6529	7127	0.0098	371	2.639E-5	14.941	13.447
1991	39.38	1.6628	7492	0.0098	355	2.764E-5	15.238	13.714
2018	39.78	1.6727	7841	0.0099	341	2.895E-5	15.546	13.991
2045	40.18	1.6827	8174	0.0099	327	3.033E-5	15.857	14.272
2072	40.59	1.6926	8492	0.0099	313	3.171E-5	16.177	14.560
2099	41.01	1.7025	8794	0.0099	298	3.311E-5	16.506	14.856
2128	41.43	1.7125	9091	0.0099	285	3.466E-5	16.839	15.155
2156	41.86	1.7225	9372	0.0099	273	3.625E-5	17.176	15.458
2184	42.27	1.7320	9629	0.0099	259	3.799E-5	17.524	15.772
2213	42.71	1.7421	9885	0.0098	246	3.992E-5	17.868	16.081
2242	43.15	1.7519	10128	0.0099	236	4.184E-5	18.228	16.405
2271	43.59	1.7616	10349	0.0099	228	4.367E-5	18.588	16.729
2300	44.03	1.7713	10564	0.0098	214	4.574E-5	18.970	17.073
2332	44.52	1.7817	10790	0.0099	201	4.888E-5	19.347	17.413
2362	44.99	1.7917	10995	0.0100	191	5.261E-5	19.736	17.762
2391	45.43	1.8010	11168	0.0099	181	5.575E-5	20.134	18.121
2423	45.91	1.8110	11332	0.0098	169	5.868E-5	20.539	18.485
2456	46.43	1.8215	11497	0.0098	160	6.157E-5	20.943	18.848
2486	46.89	1.8309	11652	0.0098	153	6.371E-5	21.376	19.238
2518	47.39	1.8407	11806	0.0099	148	6.613E-5	21.793	19.614
2551	47.89	1.8506	11952	0.0098	141	6.956E-5	22.218	19.997
2581	48.38	1.8600	12086	0.0100	135	7.377E-5	22.669	20.402
2615	48.91	1.8702	12219	0.0099	127	7.821E-5	23.119	20.807
2649	49.46	1.8805	12345	0.0099	120	8.301E-5	23.597	21.237

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
2685	50.01	1.8906	12462	0.0100	114	8.825E-5	24.066	21.660
2717	50.53	1.9001	12569	0.0194	210	9.254E-5	24.557	22.101
2751	51.08	1.9100	12672	0.0201	200	1.004E-4	25.042	22.538
	51.65	1.9201	12769					
	52.25	1.9306	12875					
2750	52.76	1.9394	12970	0.0188	201	9.340E-5	25.587	23.028
2750	53.34	1.9494	13076	0.0197	209	9.430E-5	25.765	23.188
2750	53.92	1.9591	13179	0.0197	205	9.589E-5	25.959	23.363
2750	54.52	1.9690	13281	0.0099	101	9.807E-5	26.152	23.537
2750	55.13	1.9790	13380	0.0099	99	9.979E-5	26.351	23.716
2750	55.76	1.9889	13478	0.0100	98	1.017E-4	26.553	23.897
2750	56.39	1.9990	13577	0.0100	96	1.037E-4	26.755	24.079
2750	57.02	2.0088	13671	0.0100	94	1.060E-4	26.963	24.267
2750	57.68	2.0189	13765	0.0099	92	1.085E-4	27.172	24.454
2750	58.35	2.0289	13855	0.0099	89	1.107E-4	27.384	24.645
2750	59.01	2.0388	13942	0.0100	88	1.127E-4	27.597	24.837
2750	59.68	2.0486	14027	0.0099	86	1.148E-4	27.810	25.029
2750	60.35	2.0583	14113	0.0099	84	1.171E-4	28.032	25.228
2750	61.07	2.0685	14200	0.0100	82	1.210E-4	28.250	25.425
2750	61.78	2.0784	14281	0.0099	80	1.252E-4	28.478	25.630
2750	62.50	2.0882	14357	0.0100	77	1.294E-4	28.711	25.840
2750	63.26	2.0986	14433	0.0100	75	1.335E-4	28.938	26.044
2750	63.99	2.1083	14504	0.0100	73	1.370E-4	29.178	26.260
2750	64.75	2.1182	14577	0.0099	70	1.401E-4	29.414	26.473
2750	65.53	2.1283	14648	0.0201	139	1.445E-4	29.656	26.691
2750	66.32	2.1383	14716	0.0195	131	1.492E-4	29.898	26.908
2750	67.08	2.1478	14779	0.1002	567	1.767E-4	0.000	0.000
2750	74.99	2.2385	15283	0.0999	543	1.839E-4	0.000	0.000
2750	75.86	2.2477	15322	0.0193	81	2.388E-4	32.857	29.570
2750	76.84	2.2578	15364	0.0202	81	2.488E-4	33.139	29.824
2750	77.83	2.2678	15403	0.0195	75	2.596E-4	33.430	30.086
2750	78.77	2.2773	15439	0.0100	36	2.789E-4	33.727	30.354
2750	79.75	2.2869	15472	0.0099	34	2.936E-4	34.029	30.625
2750	80.81	2.2971	15505	0.0099	32	3.103E-4	34.340	30.904
2750	81.90	2.3074	15537	0.0100	30	3.280E-4	34.655	31.189
2750	82.95	2.3172	15567	0.0099	29	3.467E-4	34.983	31.484
2750	84.05	2.3273	15595	0.0100	28	3.643E-4	35.302	31.771
2750	85.15	2.3371	15621	0.0100	27	3.804E-4	35.627	32.063
2750	86.22	2.3465	15644	0.0101	25	3.980E-4	35.973	32.374
2750	87.47	2.3573	15671	0.0100	24	4.198E-4	36.312	32.679
2750	88.67	2.3675	15696	0.0100	22	4.482E-4	36.675	33.005
2750	89.90	2.3777	15718	0.0101	21	4.872E-4	37.028	33.323
2750	91.09	2.3873	15737	0.0101	19	5.320E-4	37.385	33.644
2750	92.31	2.3971	15755	0.0100	17	5.862E-4	37.745	33.967
2750	93.57	2.4070	15771	0.0099	16	6.385E-4	38.122	34.306

Test ID 5086-FCG-45 Page 4

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK	
2750	94.95	2.4176	15787	0.0100	15	7.072E-4	38.492	34.637	
2750	96.23	2.4273	15800	0.0100	13	7.746E-4	38.889	34.994	
2749	97.60	2.4374	15813	0.0101	12	8.391E-4	39.274	35.339	*
2749	98.99	2.4475	15824	0.0101	11	9.128E-4	39.668	35.694	*
2749	100.36	2.4572	15834	0.0108	10	1.053E-3	40.081	36.064	*
2749	101.85	2.4677	15845	0.0103	9	1.205E-3	40.496	36.437	*
2749	103.38	2.4782	15854	0.0105	8	1.473E-3	41.004	36.887	*
2749	105.40	2.4919	15861	0.0106	7	1.871E-3	41.314	37.159	*
2740	106.49	2.4990	15867	0.0106	5	2.398E-3	41.849	37.631	*
2739	108.22	2.5103	15871	0.0104	4	2.988E-3	42.162	37.901	*
2737	109.87	2.5208	15874	0.0211	6	3.514E-3	42.588	38.268	*
2730	111.59	2.5314	15877	0.0199	5	3.987E-3	42.968	38.595	*
	113.12	2.5407	15879						

Automated Fatigue Crack
Growth Rate Analysis

Test ID	5086-FCG-4pt5	Geometry	C(T)
Contract	SSC 10624-01	Orientation	T-L
Material	5383-H116	Yield (ksi)	35.4
Temperature (F)	75	Modulus (Msi)	10.5
Environment	RH = 40%		

Specimen Dimensions (in)

Thickness	0.496	Height	2.400
Net Thickness	0.496	Notch Depth	1.000
Width	4.000	Gage Length	0.500

Precrack Parameters

Pmax (lbs)	859.0	Stress Ratio	0.10
Final a (in)	1.050	Kmax (ksi sqr[in])	4.41

Test Parameters

EvBP	Freq	Pmax	R	Ai	Kmaxi	C	DKi
23.720	0.50	0	0.10	1.140	2.80	4.00	0.00
31.406	0.50	0	0.10	1.451	9.69	2.00	0.00
52.250	0.50	2750	0.10	0.000	0.00	0.00	0.00

K Coeff	C Coeff
.886	1.00098
4.64	-4.66951
-13.32	18.4601
14.72	-236.825
-5.6	1214.88
.	-2143.57

Visual Observations

EvB/P	Crack(EvB/P)	Crack(visual)	Error	CAF
20.753	0.983	1.002	0.019	0.993
21.841	1.040	1.040	0.000	0.992
23.480	1.121	1.100	-0.021	0.990
23.760	1.134	1.170	0.036	0.989
26.667	1.260	1.260	0.000	0.987
27.531	1.294	1.280	-0.014	0.986
30.339	1.397	1.380	-0.017	0.983
34.274	1.524	1.490	-0.034	0.981
48.661	1.865	1.880	0.015	0.973
59.300	2.043	2.080	0.037	0.969
66.619	2.142	2.120	-0.022	0.967
101.006	2.462	2.460	-0.002	0.960

Comments

Date of test: 9/9/2006

Waveform Type Sine

Test ID 5086-FCG-4pt5 Page 1

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
	27.62	1.2978	704348					
925	27.66	1.2994	705872	0.0035	3329	1.056E-6	5.588	5.029
930	27.71	1.3013	707677	0.0039	3583	1.077E-6	5.630	5.067
937	27.76	1.3033	709455	0.0019	1698	1.121E-6	5.673	5.106
943	27.81	1.3053	711233	0.0019	1698	1.143E-6	5.720	5.148
950	27.87	1.3073	712947	0.0020	1641	1.182E-6	5.765	5.189
956	27.92	1.3092	714536	0.0020	1588	1.226E-6	5.811	5.230
962	27.96	1.3111	716061	0.0020	1535	1.276E-6	5.856	5.271
968	28.01	1.3130	717521	0.0023	1793	1.384E-6	5.903	5.313
975	28.07	1.3150	718982	0.0029	1988	1.480E-6	5.951	5.355
982	28.12	1.3171	720442	0.0034	2156	1.530E-6	6.028	5.425
996	28.23	1.3213	723707	0.0039	2298	1.686E-6	6.116	5.504
1014	28.37	1.3265	726464	0.0100	5288	1.887E-6	6.230	5.607
1031	28.50	1.3313	728995	0.0099	4844	2.034E-6	6.358	5.723
1048	28.64	1.3363	731308	0.1073	22660	4.737E-6	0.000	0.000
1467	31.56	1.4387	751655	0.1041	20492	5.082E-6	0.000	0.000
1471	31.62	1.4405	751800	0.0037	324	1.132E-5	9.731	8.758
1475	31.68	1.4423	751979	0.0040	359	1.115E-5	9.770	8.793
1479	31.74	1.4445	752159	0.0040	338	1.183E-5	9.807	8.826
1483	31.80	1.4463	752317	0.0020	173	1.133E-5	9.847	8.863
1487	31.86	1.4482	752496	0.0020	172	1.145E-5	9.886	8.897
1491	31.92	1.4503	752674	0.0020	172	1.147E-5	9.925	8.932
1495	31.98	1.4522	752839	0.0020	173	1.148E-5	9.965	8.969
1499	32.04	1.4542	753011	0.0020	170	1.158E-5	10.006	9.005
1504	32.10	1.4562	753189	0.0020	167	1.168E-5	10.046	9.041
1508	32.17	1.4582	753354	0.0020	167	1.169E-5	10.085	9.077
1512	32.22	1.4601	753513	0.0020	165	1.179E-5	10.126	9.113
1516	32.28	1.4621	753678	0.0019	161	1.201E-5	10.164	9.148
1520	32.34	1.4640	753843	0.0019	160	1.217E-5	10.205	9.185
1524	32.41	1.4660	754002	0.0020	159	1.233E-5	10.246	9.221
1528	32.47	1.4679	754154	0.0019	153	1.255E-5	10.286	9.258
1532	32.53	1.4699	754312	0.0019	150	1.286E-5	10.327	9.294
1536	32.59	1.4718	754464	0.0020	152	1.310E-5	10.367	9.330
1540	32.65	1.4736	754596	0.0038	281	1.365E-5	10.408	9.367
1544	32.71	1.4756	754745	0.0042	318	1.328E-5	10.451	9.405
1549	32.78	1.4779	754914	0.6776	-739922	-9.158E-7	0.000	0.000
2745	67.52	2.1533	14823	0.6773	-740078	-9.152E-7	0.000	0.000
2750	67.68	2.1552	14836	0.0038	26	1.469E-4	30.299	27.249
2750	67.83	2.1571	14849	0.0040	26	1.540E-4	30.377	27.338
2750	68.00	2.1592	14862	0.0040	26	1.536E-4	30.426	27.384
2750	68.16	2.1611	14875	0.0020	13	1.519E-4	30.479	27.431
2750	68.33	2.1631	14888	0.0020	13	1.511E-4	30.530	27.477
2750	68.49	2.1651	14901	0.0020	13	1.503E-4	30.581	27.523
2750	68.66	2.1671	14915	0.0020	13	1.518E-4	30.633	27.570

Test ID 5086-FCG-4pt5 Page 2

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
2750	68.82	2.1691	14928	0.0020	13	1.534E-4	30.683	27.614
2750	68.98	2.1709	14940	0.0020	13	1.551E-4	30.735	27.662
2750	69.16	2.1730	14953	0.0020	13	1.591E-4	30.787	27.708
2750	69.33	2.1751	14966	0.0020	12	1.615E-4	30.839	27.755
2750	69.49	2.1770	14978	0.0020	12	1.640E-4	30.893	27.803
2750	69.67	2.1790	14990	0.0020	12	1.671E-4	30.944	27.849
2750	69.84	2.1810	15002	0.0020	12	1.713E-4	30.997	27.898
2750	70.00	2.1830	15013	0.0020	11	1.748E-4	31.048	27.943
2750	70.17	2.1849	15024	0.0020	11	1.768E-4	31.101	27.991
2750	70.34	2.1869	15035	0.0020	11	1.789E-4	31.153	28.038
2750	70.52	2.1889	15046	0.0020	11	1.789E-4	31.207	28.086
2750	70.69	2.1910	15058	0.0020	11	1.794E-4	31.261	28.135
2750	70.87	2.1930	15069	0.0020	11	1.787E-4	31.315	28.183
2750	71.04	2.1950	15080	0.0020	12	1.781E-4	31.369	28.232
2750	71.22	2.1970	15091	0.0041	23	1.768E-4	31.423	28.281
2750	71.40	2.1990	15103	0.0042	24	1.738E-4	31.479	28.331
	71.58	2.2011	15115					

Automated Fatigue Crack
Growth Rate Analysis

Test ID	5086-FCG-4pt05	Geometry	C(T)
Contract	SSC 10624-01	Orientation	T-L
Material	5086-H116	Yield (ksi)	27.0
Temperature (F)	75	Modulus (Msi)	10.5
Environment	Sea Water		

Specimen Dimensions (in)

Thickness	0.496	Height	2.400
Net Thickness	0.496	Notch Depth	1.000
Width	4.000	Gage Length	0.500

Precrack Parameters

Pmax (lbs)	779.0	Stress Ratio	0.10
Final a (in)	1.050	Kmax (ksi sqr[in])	4.00

Test Parameters

EvBP	Freq	Pmax	R	Ai	Kmaxi	C	DKi
31.406	0.05	0	0.10	1.451	9.69	2.00	0.00
52.247	0.05	2750	0.10	0.000	0.00	0.00	0.00

K Coeff	C Coeff
.886	1.00098
4.64	-4.66951
-13.32	18.4601
14.72	-236.825
-5.6	1214.88
.	-2143.57

Visual Observations

EvB/P	Crack(EvB/P)	Crack(visual)	Error	CAF
20.726	1.014	1.001	-0.013	1.021
21.845	1.073	1.070	-0.003	1.020
22.606	1.111	1.120	0.009	1.019
23.443	1.151	1.160	0.009	1.018
23.654	1.161	1.190	0.029	1.018
27.959	1.341	1.330	-0.011	1.013
31.354	1.461	1.460	-0.001	1.010
35.099	1.576	1.550	-0.026	1.007
43.347	1.783	1.790	0.007	1.002
51.894	1.949	1.920	-0.029	0.998
67.433	2.175	2.200	0.025	0.993

Comments

Date of test: 9/10/2006
Waveform Type Sine

Test ID 5086-FCG-4pt05 Page 1

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK	
	32.94	1.5115	755158						
1562	32.97	1.5126	755226	0.0027	231	1.169E-5	10.821	9.737	
1566	33.02	1.5142	755389	0.0038	351	1.078E-5	10.864	9.777	
1570	33.09	1.5164	755577	0.0018	163	1.173E-5	10.904	9.814	
1574	33.15	1.5183	755755	0.0019	182	1.071E-5	10.950	9.855	
1579	33.22	1.5203	755947	0.0020	183	1.062E-5	10.994	9.894	
1583	33.29	1.5223	756138	0.0019	182	1.058E-5	11.037	9.933	
1587	33.35	1.5242	756316	0.0019	183	1.062E-5	11.081	9.973	
1591	33.41	1.5260	756488	0.0019	177	1.074E-5	11.124	10.011	
1595	33.47	1.5279	756667	0.0019	173	1.084E-5	11.168	10.051	
1600	33.54	1.5299	756852	0.0019	173	1.101E-5	11.210	10.089	
1604	33.60	1.5318	757010	0.0019	174	1.115E-5	11.254	10.128	
1608	33.66	1.5335	757175	0.0020	172	1.136E-5	11.298	10.168	
1612	33.72	1.5356	757354	0.0041	357	1.156E-5	11.343	10.208	
1617	33.79	1.5377	757532	0.0041	343	1.190E-5	11.389	10.250	
1621	33.86	1.5397	757697	0.6901	-742402	-9.296E-7	0.000	0.000	
2750	71.93	2.2278	15130	0.6900	-742558	-9.292E-7	0.000	0.000	
2750	72.09	2.2296	15139	0.0037	18	2.034E-4	32.322	29.095	*
2750	72.25	2.2315	15148	0.0041	21	1.935E-4	32.382	29.144	*
2750	72.45	2.2337	15160	0.0042	22	1.899E-4	32.436	29.192	*
2750	72.63	2.2356	15170	0.0020	10	2.051E-4	32.497	29.247	*
2750	72.81	2.2376	15179	0.0021	10	2.094E-4	32.556	29.300	*
2750	73.00	2.2398	15189	0.0020	9	2.150E-4	32.613	29.352	*
2750	73.18	2.2418	15198	0.0020	9	2.168E-4	32.673	29.405	*
2750	73.36	2.2438	15207	0.0020	9	2.158E-4	32.729	29.457	*
2750	73.53	2.2457	15216	0.0020	9	2.173E-4	32.788	29.509	*
2750	73.72	2.2477	15226	0.0041	19	2.166E-4	32.845	29.561	*
2750	73.91	2.2498	15235	0.0041	18	2.278E-4	32.905	29.615	*
	74.10	2.2518	15244						

Automated Fatigue Crack
Growth Rate Analysis

Test ID	5086-FCG-4Cpt05	Geometry	C(T)
Contract	SSC 10624-01	Orientation	T-L
Material	5086-H116	Yield (ksi)	27.0
Temperature (F)	75	Modulus (Msi)	10.5
Environment	Sea Water		

Specimen Dimensions (in)

Thickness	0.496	Height	2.400
Net Thickness	0.496	Notch Depth	1.000
Width	4.000	Gage Length	0.500

Precrack Parameters

Pmax (lbs)	779.0	Stress Ratio	0.10
Final a (in)	1.050	Kmax (ksi sqr[in])	4.00

Test Parameters

EvBP	Freq	Pmax	R	Ai	Kmaxi	C	DKi
31.406	0.05	0	0.10	1.451	9.69	2.00	0.00

K Coeff	C Coeff
.886	1.00098
4.64	-4.66951
-13.32	18.4601
14.72	-236.825
-5.6	1214.88
.	-2143.57

Visual Observations

EvB/P	Crack(EvB/P)	Crack(visual)	Error	CAF
20.726	1.014	1.001	-0.013	1.021
21.845	1.073	1.070	-0.003	1.020
22.606	1.111	1.120	0.009	1.019
23.443	1.151	1.160	0.009	1.018
23.654	1.161	1.190	0.029	1.018
27.959	1.341	1.330	-0.011	1.013
31.354	1.461	1.460	-0.001	1.010
35.099	1.576	1.550	-0.026	1.007
43.347	1.783	1.790	0.007	1.002
51.894	1.949	1.920	-0.029	0.998
67.433	2.175	2.200	0.025	0.993

Comments

Date of test: 9/10/2006
Waveform Type Sine

Test ID 5086-FCG-4Cpt05 Page 1

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
	33.92	1.5415	89					
1630	33.98	1.5433	190	0.0037	223	1.659E-5	11.524	10.372
1634	34.05	1.5452	312	0.0042	267	1.572E-5	11.570	10.413
1639	34.12	1.5475	457	0.0020	123	1.587E-5	11.617	10.455
1644	34.19	1.5494	583	0.0020	127	1.558E-5	11.665	10.499
1648	34.25	1.5513	705	0.0020	128	1.559E-5	11.712	10.541
1652	34.32	1.5533	827	0.0019	123	1.572E-5	11.757	10.582
1657	34.38	1.5552	953	0.0019	121	1.589E-5	11.806	10.626
1661	34.45	1.5572	1079	0.0020	121	1.602E-5	11.851	10.666
1666	34.51	1.5590	1192	0.0019	119	1.608E-5	11.899	10.709
1670	34.58	1.5610	1310	0.0019	117	1.644E-5	11.944	10.750
1675	34.65	1.5630	1431	0.0019	115	1.669E-5	11.991	10.792
1679	34.71	1.5648	1540	0.0019	113	1.699E-5	12.040	10.836
1684	34.78	1.5669	1657	0.0019	114	1.708E-5	12.085	10.876
1688	34.85	1.5687	1766	0.0020	112	1.747E-5	12.135	10.922
1693	34.91	1.5707	1870	0.0038	226	1.696E-5	12.180	10.962
1697	34.98	1.5725	1992	0.0041	235	1.762E-5	12.233	11.010
	35.06	1.5748	2105					

Automated Fatigue Crack
Growth Rate Analysis

Test ID	5086-FCG-5	Geometry	C(T)
Contract	SSC 10624-01	Orientation	T-L
Material	5086-H116	Yield (ksi)	27.0
Temperature (F)	75	Modulus (Msi)	10.5
Environment	RH = 40%		

Specimen Dimensions (in)

Thickness	0.497	Height	2.400
Net Thickness	0.497	Notch Depth	1.000
Width	4.000	Gage Length	0.500

Precrack Parameters

Pmax (lbs)	962.0	Stress Ratio	0.10
Final a (in)	1.070	Kmax (ksi sqr[in])	5.00

Test Parameters

EvBP	Freq	Pmax	R	Ai	Kmaxi	C	DKi
22.290	24.00	0	0.10	1.070	5.00	-4.00	0.00
24.852	24.00	0	0.10	1.190	3.40	4.00	0.00

K Coeff	C Coeff	da/dN Fit Parameters (DKapp)	
.886	1.00098	Upper da/dN limit	3.937E-8
4.64	-4.66951	Lower da/dN limit	3.937E-9
-13.32	18.4601	da/dN intercept (C)	3.743E-29
14.72	-236.825	da/dN slope (m)	41.858
-5.6	1214.88	da/dN for delta K	3.937E-9
.	-2143.57	delta K	3.008

Visual Observations

EvB/P	Crack(EvB/P)	Crack(visual)	Error	CAF
20.547	0.990	1.000	0.011	1.009
22.223	1.089	1.070	-0.019	1.016
24.200	1.194	1.190	-0.004	1.024
24.485	1.208	1.220	0.012	1.025
25.589	1.242	1.250	0.008	1.011
28.155	1.334	1.325	-0.009	0.999
31.334	1.435	1.430	-0.005	0.987
36.192	1.569	1.575	0.006	0.971

Comments

Date of test: 9/19/2006
Waveform Type Sine

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Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
	22.29	1.0928	9610					
928	22.37	1.0972	21809	0.0099	29163	3.389E-7	4.905	4.414
907	22.47	1.1026	38773	0.0107	35479	3.005E-7	4.820	4.338
887	22.57	1.1079	57288	0.0053	20154	2.987E-7	4.724	4.252
866	22.67	1.1135	79640	0.0055	22614	2.590E-7	4.632	4.169
845	22.77	1.1193	105089	0.0055	24474	2.334E-7	4.542	4.088
826	22.87	1.1245	130533	0.0055	25268	2.154E-7	4.449	4.004
807	22.98	1.1302	157491	0.0053	27199	2.021E-7	4.364	3.928
788	23.08	1.1357	185617	0.0053	30028	1.920E-7	4.282	3.854
772	23.17	1.1407	208893	0.0055	33464	1.847E-7	4.198	3.779
755	23.26	1.1452	242836	0.0054	37154	1.675E-7	4.123	3.711
738	23.37	1.1511	285255	0.0055	39032	1.447E-7	4.029	3.626
715	23.49	1.1575	331318	0.0054	43992	1.292E-7	3.962	3.566
703	23.58	1.1624	380414	0.0056	50772	1.200E-7	3.866	3.479
684	23.70	1.1686	419811	0.0055	58616	1.138E-7	3.805	3.424
670	23.79	1.1732	472844	0.0052	67607	1.020E-7	3.726	3.353
655	23.90	1.1785	547467	0.0048	76435	8.309E-8	3.656	3.290
640	24.01	1.1842	636950	0.0041	86511	5.617E-8	3.591	3.232
628	24.09	1.1885	736959	0.0035	94315	3.915E-8	3.537	3.183
620	24.14	1.1911	839022	0.0027	98521	2.634E-8	3.495	3.146
615	24.18	1.1931	938878	0.0019	100250	1.747E-8	3.472	3.124
612	24.20	1.1939	1038734	0.0014	100838	1.289E-8	3.456	3.110
611	24.21	1.1946	1138591	0.0012	100470	1.112E-8	3.442	3.098
608	24.23	1.1956	1238447	0.0011	100470	1.080E-8	3.430	3.087
604	24.26	1.1970	1341989	0.0011	100471	1.125E-8	3.416	3.074
601	24.29	1.1983	1441844	0.0011	100471	1.095E-8	3.398	3.058
598	24.31	1.1995	1541700	0.0009	100468	9.168E-9	3.386	3.048
596	24.33	1.2003	1641557	0.0006	99854	6.044E-9	3.373	3.036
594	24.34	1.2009	1741414	0.0005	99854	4.054E-9	3.363	3.026
592	24.34	1.2009	1841257	-0.0005	199697	-2.307E-9	3.357	3.021
592	24.33	1.2005	1941111	0.0003	199710	1.530E-9	3.351	3.016
592	24.34	1.2012	2040967	0.0745	-1011432	-7.369E-8	0.000	0.000
783	26.49	1.2750	929679	0.0779	-1091165	-7.140E-8	0.000	0.000
796	26.60	1.2792	949802	0.0086	38114	2.256E-7	4.741	4.267
809	26.72	1.2836	967793	0.0088	33336	2.634E-7	4.833	4.349
823	26.84	1.2879	983138	0.0087	28228	3.089E-7	4.929	4.436
837	26.97	1.2923	996021	0.0044	13200	3.453E-7	5.024	4.522
850	27.08	1.2966	1007541	0.0044	11575	3.871E-7	5.122	4.610
864	27.20	1.3007	1018820	0.0044	10181	4.427E-7	5.225	4.702
880	27.34	1.3055	1029002	0.0044	9069	5.114E-7	5.326	4.793
895	27.46	1.3098	1037242	0.0044	8132	5.856E-7	5.434	4.891
910	27.59	1.3142	1044225	0.0045	7091	6.629E-7	5.541	4.987
925	27.71	1.3185	1050435	0.0044	6131	7.452E-7	5.651	5.086
941	27.84	1.3231	1056334	0.0044	5454	8.287E-7	5.763	5.187

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
957	27.97	1.3274	1061365	0.0044	4952	9.127E-7	5.879	5.291
973	28.10	1.3318	1065787	0.0045	4514	1.007E-6	5.992	5.393
989	28.22	1.3360	1069963	0.0044	4008	1.123E-6	6.113	5.502
1006	28.35	1.3406	1073939	0.0044	3594	1.260E-6	6.233	5.610
1024	28.49	1.3452	1077518	0.0044	3259	1.421E-6	6.359	5.723
1041	28.62	1.3496	1080382	0.0045	2923	1.594E-6	6.485	5.837
1058	28.75	1.3538	1082926	0.0044	2565	1.791E-6	6.613	5.951
1076	28.88	1.3582	1085340	0.0044	2239	2.019E-6	6.744	6.069
1095	29.02	1.3627	1087499	0.0044	2006	2.296E-6	6.876	6.188
1113	29.15	1.3672	1089328	0.0044	1799	2.589E-6	7.014	6.313
1132	29.29	1.3715	1090954	0.0044	1592	2.904E-6	7.154	6.439
1151	29.43	1.3760	1092418	0.0044	1406	3.255E-6	7.295	6.565
1171	29.56	1.3804	1093719	0.0044	1258	3.654E-6	7.440	6.696
1190	29.70	1.3848	1094889	0.0044	1126	4.054E-6	7.588	6.829
1211	29.84	1.3892	1095933	0.0044	1014	4.454E-6	7.739	6.966
1232	29.98	1.3938	1096876	0.0044	921	4.882E-6	7.891	7.102
1252	30.11	1.3979	1097711	0.0044	844	5.257E-6	8.046	7.241
1272	30.25	1.4023	1098502	0.0044	781	5.641E-6	8.205	7.384
1294	30.40	1.4068	1099246	0.0044	725	6.091E-6	8.361	7.525
1316	30.53	1.4110	1099951	0.0044	675	6.571E-6	8.531	7.678
1338	30.68	1.4155	1100621	0.0044	633	7.067E-6	8.699	7.829
1361	30.83	1.4202	1101225	0.0044	595	7.573E-6	8.869	7.982
1383	30.97	1.4243	1101763	0.0087	1077	8.052E-6	9.049	8.144
1407	31.11	1.4288	1102302	0.0091	1051	8.619E-6	9.226	8.304
	31.27	1.4334	1102814					

Automated Fatigue Crack
Growth Rate Analysis

Test ID	5383-FCG-1	Geometry	C(T)
Contract	SSC 10624-01	Orientation	T-L
Material	5383-H116	Yield (ksi)	35.4
Temperature (F)	75	Modulus (Msi)	10.5
Environment	RH = 40%		

Specimen Dimensions (in)

Thickness	0.488	Height	2.400
Net Thickness	0.488	Notch Depth	1.000
Width	4.000	Gage Length	0.500

Precrack Parameters

Pmax (lbs)	861.0	Stress Ratio	0.10
Final a (in)	1.050	Kmax (ksi sqr[in])	4.50

Test Parameters

EvBP	Freq	Pmax	R	Ai	Kmaxi	C	DKi
24.226	10.00	0	0.10	1.170	3.00	2.00	0.00
32.427	10.00	0	0.10	1.486	10.58	2.00	0.00
51.111	5.00	2675	0.10	0.000	0.00	0.00	0.00

K Coeff	C Coeff
.886	1.00098
4.64	-4.66951
-13.32	18.4601
14.72	-236.825
-5.6	1214.88
.	-2143.57

Visual Observations

EvB/P	Crack(EvB/P)	Crack(visual)	Error	CAF
20.829	0.994	1.001	0.007	0.999
21.843	1.046	1.045	-0.001	0.996
24.198	1.157	1.160	0.003	0.991
24.815	1.184	1.185	0.001	0.990
26.085	1.237	1.235	-0.002	0.988
28.304	1.322	1.315	-0.007	0.984
32.405	1.461	1.455	-0.006	0.977
43.793	1.755	1.760	0.005	0.965
50.785	1.892	1.890	-0.002	0.959
98.246	2.423	2.425	0.002	0.937

Comments

Date of test: 8/24/2006
Waveform Type Sine

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Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
	24.23	1.1583	21299					
534	24.31	1.1621	84307	0.0088	141260	6.236E-8	3.014	2.712
544	24.43	1.1671	162559	0.0097	149583	6.490E-8	3.068	2.761
553	24.53	1.1718	233890	0.0047	66040	7.106E-8	3.131	2.818
562	24.64	1.1765	297453	0.0049	64780	7.560E-8	3.193	2.874
572	24.75	1.1813	356275	0.0048	59979	8.078E-8	3.258	2.932
582	24.87	1.1863	417537	0.0048	55917	8.680E-8	3.324	2.992
592	24.99	1.1912	472986	0.0048	52897	9.193E-8	3.392	3.053
602	25.10	1.1960	522431	0.0049	50414	9.707E-8	3.461	3.115
612	25.21	1.2008	569390	0.0048	47020	1.027E-7	3.529	3.176
622	25.32	1.2055	614832	0.0048	44090	1.084E-7	3.601	3.241
633	25.44	1.2104	658759	0.0048	41908	1.148E-7	3.673	3.305
644	25.56	1.2152	699657	0.0048	39888	1.214E-7	3.747	3.372
654	25.67	1.2200	737525	0.0048	37616	1.285E-7	3.824	3.441
666	25.79	1.2249	773879	0.0048	35596	1.352E-7	3.900	3.510
677	25.91	1.2297	808718	0.0048	33829	1.418E-7	3.979	3.581
688	26.02	1.2344	840527	0.0048	32012	1.485E-7	4.059	3.653
700	26.14	1.2392	872337	0.0047	30396	1.560E-7	4.139	3.725
712	26.26	1.2440	902631	0.0047	28831	1.643E-7	4.222	3.800
724	26.38	1.2486	929595	0.0047	27368	1.734E-7	4.306	3.876
736	26.50	1.2533	956256	0.0047	25661	1.851E-7	4.391	3.952
748	26.62	1.2581	981706	0.0048	24005	1.987E-7	4.478	4.030
761	26.74	1.2628	1004732	0.0048	22582	2.139E-7	4.569	4.112
774	26.86	1.2676	1026304	0.0048	20885	2.322E-7	4.660	4.194
787	26.98	1.2725	1046663	0.0048	19099	2.562E-7	4.755	4.279
800	27.11	1.2773	1065085	0.0048	17251	2.870E-7	4.850	4.365
814	27.23	1.2821	1081564	0.0048	15310	3.290E-7	4.950	4.455
828	27.36	1.2871	1096297	0.0048	13407	3.827E-7	5.048	4.544
842	27.48	1.2917	1108239	0.0048	11594	4.467E-7	5.150	4.635
856	27.61	1.2964	1118166	0.0048	9920	5.241E-7	5.252	4.727
870	27.73	1.3011	1127103	0.0047	8365	6.138E-7	5.357	4.821
885	27.86	1.3059	1134650	0.0047	7179	7.125E-7	5.465	4.919
901	27.99	1.3109	1141085	0.0048	6278	8.166E-7	5.574	5.016
916	28.12	1.3155	1146484	0.0048	5433	9.261E-7	5.686	5.118
931	28.24	1.3201	1151311	0.0047	4744	1.040E-6	5.800	5.220
947	28.38	1.3250	1155836	0.0048	4240	1.162E-6	5.914	5.323
963	28.51	1.3298	1159698	0.0048	3828	1.302E-6	6.033	5.430
979	28.63	1.3344	1163113	0.0048	3414	1.460E-6	6.156	5.541
996	28.77	1.3394	1166527	0.0048	3007	1.655E-6	6.281	5.653
1013	28.91	1.3445	1169454	0.0048	2711	1.852E-6	6.409	5.768
1030	29.04	1.3492	1171795	0.0049	2471	2.045E-6	6.537	5.883
1047	29.17	1.3537	1173878	0.0048	2184	2.246E-6	6.667	6.000
1065	29.31	1.3584	1175961	0.0047	1933	2.487E-6	6.801	6.121
1084	29.45	1.3636	1177940	0.0047	1766	2.751E-6	6.938	6.244

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
1102	29.59	1.3683	1179628	0.0048	1631	3.031E-6	7.079	6.371
1121	29.72	1.3730	1181049	0.0048	1482	3.308E-6	7.218	6.496
1138	29.85	1.3775	1182390	0.0047	1339	3.582E-6	7.361	6.625
1158	29.99	1.3823	1183665	0.0047	1236	3.864E-6	7.506	6.756
1178	30.14	1.3872	1184855	0.0048	1159	4.135E-6	7.656	6.890
1197	30.28	1.3919	1185975	0.0048	1085	4.424E-6	7.812	7.031
1218	30.42	1.3968	1187042	0.0048	1022	4.721E-6	7.966	7.169
1238	30.56	1.4015	1188003	0.0048	959	5.032E-6	8.126	7.313
1259	30.70	1.4062	1188899	0.0048	899	5.350E-6	8.289	7.460
1281	30.85	1.4111	1189795	0.0048	842	5.725E-6	8.455	7.609
1302	31.00	1.4159	1190607	0.0048	797	6.063E-6	8.628	7.765
1325	31.14	1.4207	1191371	0.0048	758	6.408E-6	8.802	7.922
1347	31.29	1.4256	1192096	0.0048	710	6.784E-6	8.978	8.081
1370	31.44	1.4303	1192787	0.0048	671	7.132E-6	9.159	8.243
1393	31.59	1.4352	1193444	0.0048	635	7.498E-6	9.345	8.410
1417	31.74	1.4400	1194057	0.0047	601	7.903E-6	9.527	8.574
1440	31.88	1.4446	1194633	0.0048	567	8.384E-6	9.718	8.747
1464	32.03	1.4493	1195182	0.0095	1070	8.871E-6	9.907	8.916
1488	32.18	1.4541	1195703	0.0096	1008	9.554E-6	10.106	9.095
	32.33	1.4589	1196190					
	32.43	1.4618	1196914					
1545	32.72	1.4710	1197845	0.0190	1943	9.781E-6	10.615	9.553
1567	33.04	1.4808	1198857	0.0199	1945	1.022E-5	10.822	9.740
1589	33.37	1.4908	1199790	0.0193	1763	1.095E-5	11.035	9.932
1609	33.69	1.5001	1200620	0.0097	866	1.121E-5	11.257	10.131
1631	34.00	1.5095	1201449	0.0097	812	1.184E-5	11.480	10.332
1654	34.34	1.5194	1202278	0.0096	772	1.246E-5	11.707	10.536
1676	34.68	1.5292	1203038	0.0097	743	1.308E-5	11.944	10.750
1699	35.02	1.5389	1203730	0.0097	707	1.372E-5	12.182	10.964
1722	35.36	1.5485	1204420	0.0096	669	1.437E-5	12.425	11.183
1745	35.70	1.5581	1205077	0.0096	639	1.494E-5	12.672	11.405
1769	36.05	1.5676	1205690	0.0096	615	1.552E-5	12.923	11.631
1792	36.40	1.5772	1206293	0.0096	591	1.619E-5	13.176	11.859
1816	36.75	1.5865	1206870	0.0096	569	1.688E-5	13.439	12.095
1840	37.11	1.5963	1207418	0.0097	548	1.762E-5	13.702	12.332
1865	37.48	1.6060	1207967	0.0097	524	1.846E-5	13.980	12.582
1890	37.86	1.6158	1208489	0.0097	500	1.942E-5	14.263	12.837
1917	38.25	1.6257	1208976	0.0097	478	2.042E-5	14.546	13.092
1942	38.62	1.6351	1209435	0.0096	449	2.151E-5	14.843	13.359
1968	39.02	1.6450	1209872	0.0096	424	2.267E-5	15.135	13.622
1994	39.41	1.6547	1210287	0.0096	403	2.394E-5	15.431	13.888
2020	39.78	1.6638	1210661	0.0096	381	2.514E-5	15.740	14.166
2047	40.19	1.6735	1211035	0.0096	363	2.646E-5	16.048	14.443
2074	40.60	1.6834	1211391	0.0096	343	2.799E-5	16.362	14.726
2101	40.99	1.6926	1211721	0.0097	326	2.964E-5	16.695	15.026

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
2129	41.42	1.7026	1212049	0.0096	308	3.148E-5	17.022	15.320
2157	41.85	1.7123	1212347	0.0096	291	3.336E-5	17.362	15.626
2185	42.27	1.7218	1212618	0.0097	275	3.534E-5	17.707	15.937
2214	42.70	1.7313	1212880	0.0097	256	3.764E-5	18.056	16.251
2243	43.14	1.7411	1213137	0.0097	242	4.015E-5	18.413	16.572
2272	43.58	1.7508	1213372	0.0098	230	4.273E-5	18.782	16.904
2302	44.04	1.7606	1213587	0.0097	216	4.549E-5	19.158	17.242
2333	44.50	1.7704	1213797	0.0097	202	4.841E-5	19.546	17.591
2364	44.98	1.7804	1213999	0.0098	190	5.172E-5	19.930	17.938
2393	45.44	1.7897	1214173	0.0098	179	5.492E-5	20.332	18.299
2424	45.91	1.7994	1214346	0.0097	165	5.909E-5	20.741	18.667
2458	46.43	1.8098	1214514	0.0097	153	6.392E-5	21.146	19.031
2488	46.90	1.8192	1214659	0.0097	144	6.854E-5	21.573	19.416
2519	47.38	1.8286	1214788	0.0097	134	7.319E-5	21.997	19.797
2552	47.89	1.8384	1214916	0.0097	124	7.856E-5	22.427	20.185
2585	48.41	1.8481	1215038	0.0097	117	8.371E-5	22.871	20.585
2617	48.91	1.8577	1215149	0.0098	111	8.849E-5	23.335	21.002
2652	49.46	1.8678	1215256	0.0198	209	9.473E-5	23.792	21.413
2685	49.99	1.8775	1215358	0.0194	198	9.810E-5	24.274	21.846
	50.54	1.8872	1215454					
	51.11	1.8974	1215566					
2675	51.61	1.9062	1215661	0.0185	197	9.368E-5	24.702	22.231
2675	52.17	1.9159	1215763	0.0199	200	9.952E-5	24.876	22.388
2675	52.78	1.9261	1215861	0.0200	187	1.071E-4	25.055	22.550
2675	53.36	1.9359	1215950	0.0099	91	1.087E-4	25.241	22.717
2675	53.95	1.9456	1216035	0.0099	87	1.126E-4	25.424	22.881
2675	54.53	1.9550	1216121	0.0098	85	1.156E-4	25.615	23.053
2675	55.17	1.9653	1216206	0.0097	83	1.176E-4	25.801	23.221
2675	55.79	1.9751	1216287	0.0097	81	1.197E-4	25.999	23.399
2675	56.42	1.9849	1216369	0.0098	79	1.229E-4	26.189	23.570
2675	57.03	1.9943	1216446	0.0097	76	1.269E-4	26.385	23.746
2675	57.67	2.0040	1216522	0.0097	73	1.326E-4	26.583	23.924
2675	58.34	2.0140	1216596	0.0097	70	1.391E-4	26.780	24.101
2675	58.98	2.0234	1216659	0.0098	69	1.432E-4	26.985	24.286
2675	59.65	2.0331	1216724	0.0098	67	1.471E-4	27.191	24.472
2675	60.36	2.0431	1216790	0.0098	65	1.506E-4	27.399	24.659
2675	61.06	2.0529	1216858	0.0099	64	1.530E-4	27.613	24.852
2675	61.76	2.0626	1216921	0.0099	64	1.559E-4	27.831	25.048
2675	62.50	2.0727	1216983	0.0098	62	1.591E-4	28.050	25.245
2675	63.24	2.0826	1217043	0.0098	60	1.634E-4	28.277	25.449
2675	64.00	2.0926	1217105	0.0098	58	1.688E-4	28.500	25.650
2675	64.74	2.1022	1217162	0.0098	55	1.764E-4	28.726	25.853
2675	65.49	2.1117	1217216	0.0098	53	1.847E-4	28.954	26.059
2675	66.27	2.1216	1217266	0.0097	51	1.935E-4	29.187	26.268
2675	67.09	2.1316	1217315	0.0099	48	2.041E-4	29.422	26.479

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Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK (ksi[in]^.5)	
2675	67.87	2.1412	1217362	0.0099	46	2.158E-4	29.665	26.698	
2675	68.69	2.1509	1217408	0.0099	43	2.303E-4	29.914	26.922	
2675	69.59	2.1615	1217452	0.0098	41	2.442E-4	30.160	27.144	
2675	70.44	2.1713	1217490	0.0099	39	2.544E-4	30.419	27.377	
2675	71.29	2.1810	1217524	0.0099	38	2.635E-4	30.667	27.600	
2675	72.13	2.1904	1217560	0.0097	35	2.727E-4	30.927	27.834	
2675	73.04	2.2004	1217598	0.0099	34	2.836E-4	31.182	28.063	
2675	73.95	2.2102	1217633	0.0098	34	2.919E-4	31.447	28.301	
2675	74.85	2.2198	1217663	0.0099	33	3.009E-4	31.728	28.554	
2675	75.87	2.2304	1217696	0.0099	32	3.121E-4	31.995	28.795	
2675	76.81	2.2401	1217728	0.0100	31	3.223E-4	32.285	29.056	
2675	77.79	2.2499	1217759	0.0100	30	3.334E-4	32.569	29.311	
2675	78.81	2.2601	1217789	0.0099	28	3.537E-4	32.860	29.573	
2675	79.85	2.2702	1217817	0.0099	27	3.780E-4	33.150	29.834	
2675	80.84	2.2797	1217841	0.0099	25	4.005E-4	33.450	30.103	
2675	81.89	2.2895	1217864	0.0099	23	4.287E-4	33.746	30.369	
2675	82.97	2.2995	1217887	0.0098	21	4.615E-4	34.053	30.646	
2675	84.08	2.3095	1217909	0.0100	20	5.041E-4	34.369	30.930	
2675	85.22	2.3197	1217928	0.0100	19	5.473E-4	34.681	31.210	
2675	86.32	2.3293	1217945	0.0099	17	5.970E-4	35.014	31.510	
2675	87.53	2.3396	1217961	0.0099	16	6.399E-4	35.330	31.794	
2675	88.68	2.3493	1217976	0.0099	15	6.795E-4	35.666	32.095	
2675	89.85	2.3590	1217989	0.0099	14	7.162E-4	36.000	32.396	
2675	91.08	2.3689	1218003	0.0098	13	7.557E-4	36.340	32.701	
2675	92.34	2.3790	1218016	0.0099	12	8.065E-4	36.689	33.015	
2674	93.62	2.3889	1218028	0.0100	12	8.658E-4	37.038	33.329	
2674	94.87	2.3985	1218039	0.0103	11	9.432E-4	37.397	33.651	
2674	96.19	2.4084	1218049	0.0100	10	1.002E-3	37.767	33.983	
2674	97.63	2.4190	1218059	0.0101	10	1.071E-3	38.148	34.315	
2670	99.24	2.4308	1218069	0.0103	9	1.148E-3	38.531	34.669	
2673	100.38	2.4391	1218077	0.0105	9	1.207E-3	38.941	35.025	
2674	101.83	2.4495	1218085	0.0105	8	1.277E-3	39.343	35.400	*
2674	103.39	2.4604	1218093	0.0101	8	1.361E-3	39.768	35.778	*
2673	104.97	2.4712	1218101	0.0105	7	1.472E-3	40.208	36.173	*
2673	106.55	2.4818	1218108	0.0106	7	1.603E-3	40.631	36.551	*
2673	108.05	2.4916	1218114	0.0105	6	1.738E-3	41.080	36.953	*
2672	109.72	2.5023	1218120	0.0103	6	1.914E-3	41.508	37.330	*
2671	111.39	2.5128	1218125	0.0103	5	2.091E-3	41.964	37.735	*
2670	113.08	2.5232	1218130	0.0105	5	2.306E-3	42.416	38.138	*
2672	114.68	2.5328	1218134	0.0104	4	2.425E-3	42.870	38.534	*
2669	116.48	2.5434	1218138	0.0104	4	2.606E-3	43.374	38.990	*
2669	118.47	2.5549	1218142	0.0103	4	2.799E-3	43.833	39.393	*
2669	120.18	2.5645	1218146	0.0106	4	2.924E-3	44.352	39.854	*
2667	122.12	2.5751	1218149	0.0108	4	3.068E-3	44.816	40.259	*
2666	123.93	2.5849	1218152	0.0105	3	3.292E-3	45.352	40.729	*

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Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK (ksi[in]^.5)	
2664	126.17	2.5966	1218156	0.0107	3	3.774E-3	45.830	41.135	*
2657	128.45	2.6083	1218159	0.0107	3	4.345E-3	46.308	41.535	*
2650	130.35	2.6178	1218161	0.0105	3	4.563E-3	46.804	41.944	*
2645	132.55	2.6285	1218163	0.0218	4	5.453E-3	47.099	42.139	*
2623	134.88	2.6396	1218165	0.0193	4	4.835E-3	47.459	42.385	*
	136.66	2.6479	1218167						

Automated Fatigue Crack
Growth Rate Analysis

Test ID	5383-FCG-2	Geometry	C(T)
Contract	SSC 10624-01	Orientation	T-L
Material	5383-H116	Yield (ksi)	35.4
Temperature (F)	75	Modulus (Msi)	10.5
Environment	RH = 40%		

Specimen Dimensions (in)

Thickness	0.487	Height	2.400
Net Thickness	0.487	Notch Depth	1.000
Width	4.001	Gage Length	0.500

Precrack Parameters

Pmax (lbs)	861.0	Stress Ratio	0.10
Final a (in)	1.050	Kmax (ksi sqr[in])	4.50

Test Parameters

EvBP	Freq	Pmax	R	Ai	Kmaxi	C	DKi
24.663	10.00	0	0.10	1.180	3.00	4.00	0.00
32.708	10.00	0	0.10	1.495	10.56	2.00	0.00
50.476	5.00	2590	0.10	0.000	0.00	0.00	0.00

K Coeff	C Coeff
.886	1.00098
4.64	-4.66951
-13.32	18.4601
14.72	-236.825
-5.6	1214.88
.	-2143.57

Visual Observations

EvB/P	Crack(EvB/P)	Crack(visual)	Error	CAF
20.552	0.994	1.000	0.006	1.013
21.843	1.061	1.060	-0.001	1.009
23.970	1.160	1.160	0.000	1.003
24.563	1.186	1.185	-0.001	1.001
27.161	1.290	1.285	-0.005	0.995
28.537	1.341	1.340	-0.001	0.992
32.684	1.478	1.475	-0.003	0.985
50.171	1.884	1.890	0.006	0.963
102.347	2.451	2.450	-0.001	0.933

Comments

Date of test: 8/30/2006
Waveform Type Sine

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Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
	24.66	1.1898	17589					
547	24.73	1.1925	51634	0.0076	91844	8.322E-8	3.157	2.841
557	24.84	1.1974	109433	0.0096	109507	8.759E-8	3.206	2.886
566	24.95	1.2021	161141	0.0044	48565	9.160E-8	3.271	2.944
576	25.06	1.2067	211789	0.0048	50194	9.510E-8	3.339	3.005
586	25.18	1.2117	263538	0.0048	47751	1.003E-7	3.404	3.063
596	25.29	1.2164	308981	0.0048	45798	1.052E-7	3.476	3.128
606	25.42	1.2213	352797	0.0048	43416	1.108E-7	3.545	3.190
617	25.53	1.2262	395940	0.0048	40850	1.166E-7	3.617	3.256
627	25.65	1.2309	435931	0.0048	39335	1.219E-7	3.690	3.321
637	25.76	1.2355	472285	0.0048	37587	1.270E-7	3.764	3.387
648	25.88	1.2403	508639	0.0047	35445	1.330E-7	3.840	3.456
660	26.00	1.2452	544992	0.0047	34082	1.389E-7	3.917	3.526
671	26.12	1.2500	578316	0.0048	33072	1.439E-7	3.996	3.596
682	26.24	1.2545	608611	0.0047	31507	1.500E-7	4.077	3.669
694	26.36	1.2593	640421	0.0047	29690	1.571E-7	4.157	3.742
705	26.48	1.2641	670715	0.0047	28175	1.658E-7	4.242	3.818
718	26.60	1.2688	697679	0.0047	26964	1.755E-7	4.325	3.892
729	26.71	1.2733	723129	0.0047	25096	1.871E-7	4.413	3.971
742	26.84	1.2780	747366	0.0047	23278	2.016E-7	4.498	4.049
754	26.96	1.2828	770392	0.0047	21693	2.186E-7	4.588	4.129
767	27.08	1.2873	790994	0.0047	20036	2.379E-7	4.681	4.213
780	27.21	1.2922	810385	0.0047	18323	2.628E-7	4.773	4.296
793	27.33	1.2969	827836	0.0047	16450	2.940E-7	4.869	4.382
806	27.45	1.3015	843346	0.0047	14774	3.330E-7	4.967	4.470
820	27.58	1.3063	857303	0.0047	13032	3.804E-7	5.065	4.558
834	27.71	1.3109	869090	0.0047	11381	4.382E-7	5.169	4.652
848	27.84	1.3158	879639	0.0048	9922	5.106E-7	5.270	4.743
862	27.96	1.3203	888575	0.0048	8548	5.974E-7	5.377	4.839
877	28.09	1.3250	896122	0.0047	7346	6.988E-7	5.485	4.936
892	28.22	1.3300	902875	0.0047	6266	8.158E-7	5.596	5.036
908	28.36	1.3349	908591	0.0047	5420	9.424E-7	5.709	5.138
923	28.49	1.3394	913164	0.0047	4738	1.056E-6	5.823	5.240
938	28.61	1.3439	917232	0.0047	4127	1.180E-6	5.939	5.345
954	28.75	1.3488	921094	0.0047	3614	1.335E-6	6.055	5.449
970	28.88	1.3534	924549	0.0047	3238	1.507E-6	6.178	5.560
986	29.01	1.3582	927639	0.0047	2924	1.684E-6	6.303	5.673
1004	29.15	1.3630	930273	0.0047	2610	1.870E-6	6.428	5.785
1021	29.28	1.3676	932589	0.0047	2344	2.063E-6	6.556	5.901
1037	29.41	1.3721	934777	0.0047	2092	2.285E-6	6.686	6.017
1055	29.55	1.3769	936756	0.0047	1888	2.537E-6	6.818	6.137
1073	29.69	1.3817	938610	0.0047	1725	2.824E-6	6.954	6.259
1091	29.83	1.3864	940193	0.0047	1559	3.131E-6	7.095	6.386
1109	29.97	1.3911	941598	0.0048	1425	3.423E-6	7.236	6.513

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
1128	30.11	1.3958	942940	0.0048	1294	3.733E-6	7.382	6.644
1147	30.25	1.4005	944130	0.0047	1181	4.028E-6	7.531	6.778
1167	30.39	1.4054	945304	0.0047	1096	4.351E-6	7.684	6.916
1187	30.54	1.4102	946371	0.0047	1022	4.684E-6	7.835	7.052
1206	30.67	1.4146	947278	0.0047	952	5.018E-6	7.992	7.193
1226	30.81	1.4193	948174	0.0047	876	5.384E-6	8.151	7.336
1248	30.97	1.4243	949070	0.0047	819	5.743E-6	8.312	7.481
1269	31.11	1.4290	949839	0.0047	783	6.082E-6	8.480	7.632
1290	31.25	1.4335	950560	0.0048	738	6.460E-6	8.647	7.782
1311	31.40	1.4382	951286	0.0047	685	6.868E-6	8.822	7.939
1334	31.55	1.4431	951977	0.0047	657	7.254E-6	8.996	8.097
1357	31.70	1.4479	952599	0.0048	628	7.663E-6	9.179	8.261
1380	31.85	1.4525	953177	0.0048	592	8.056E-6	9.366	8.429
1404	32.01	1.4574	953781	0.0047	564	8.404E-6	9.554	8.599
1428	32.16	1.4622	954330	0.0047	541	8.720E-6	9.747	8.773
1452	32.31	1.4668	954839	0.0093	1033	9.000E-6	9.944	8.950
1476	32.46	1.4715	955363	0.0094	1005	9.345E-6	10.139	9.125
	32.61	1.4762	955844					
	32.71	1.4791	956507					
1533	33.00	1.4880	957438	0.0189	1874	1.007E-5	10.658	9.591
1555	33.34	1.4979	958381	0.0193	1842	1.050E-5	10.859	9.773
1576	33.65	1.5073	959280	0.0190	1728	1.098E-5	11.078	9.970
1597	33.98	1.5169	960109	0.0095	831	1.144E-5	11.294	10.165
1618	34.30	1.5262	960904	0.0094	789	1.193E-5	11.519	10.367
1640	34.63	1.5357	961699	0.0095	754	1.256E-5	11.745	10.571
1662	34.97	1.5453	962424	0.0096	726	1.318E-5	11.974	10.776
1684	35.30	1.5544	963115	0.0096	691	1.385E-5	12.217	10.995
1708	35.66	1.5644	963806	0.0096	654	1.461E-5	12.460	11.214
1732	36.03	1.5743	964463	0.0096	625	1.537E-5	12.710	11.439
1754	36.37	1.5835	965048	0.0095	595	1.607E-5	12.969	11.672
1778	36.73	1.5931	965624	0.0095	567	1.677E-5	13.222	11.900
1802	37.09	1.6027	966173	0.0094	537	1.754E-5	13.481	12.133
1826	37.44	1.6117	966682	0.0095	516	1.825E-5	13.751	12.376
1851	37.82	1.6214	967207	0.0095	497	1.905E-5	14.018	12.617
1875	38.20	1.6310	967687	0.0095	478	1.988E-5	14.296	12.866
1900	38.57	1.6402	968146	0.0096	463	2.078E-5	14.581	13.123
1925	38.96	1.6499	968605	0.0096	438	2.178E-5	14.870	13.383
1952	39.36	1.6597	969042	0.0095	417	2.280E-5	15.170	13.653
1978	39.76	1.6695	969457	0.0096	400	2.403E-5	15.470	13.924
2004	40.15	1.6787	969832	0.0096	379	2.534E-5	15.774	14.197
2029	40.54	1.6879	970187	0.0095	357	2.671E-5	16.088	14.479
2057	40.97	1.6978	970543	0.0095	335	2.830E-5	16.405	14.764
2085	41.40	1.7076	970881	0.0095	320	2.997E-5	16.732	15.059
2112	41.81	1.7169	971183	0.0097	306	3.169E-5	17.065	15.358
2139	42.23	1.7263	971468	0.0096	287	3.355E-5	17.402	15.662

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Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
2168	42.67	1.7360	971752	0.0095	266	3.578E-5	17.750	15.975
2197	43.12	1.7460	972023	0.0095	253	3.804E-5	18.103	16.293
2226	43.56	1.7554	972263	0.0096	240	4.038E-5	18.461	16.615
2254	44.00	1.7646	972478	0.0096	223	4.303E-5	18.827	16.945
2284	44.45	1.7741	972698	0.0095	209	4.587E-5	19.195	17.276
2314	44.93	1.7840	972908	0.0096	198	4.865E-5	19.577	17.619
2344	45.40	1.7936	973091	0.0096	188	5.133E-5	19.969	17.972
2374	45.87	1.8032	973274	0.0097	177	5.468E-5	20.363	18.327
2405	46.35	1.8128	973448	0.0097	166	5.845E-5	20.763	18.687
2435	46.84	1.8222	973606	0.0097	156	6.243E-5	21.178	19.060
2467	47.35	1.8321	973758	0.0096	144	6.763E-5	21.608	19.447
2501	47.88	1.8423	973903	0.0096	133	7.383E-5	22.033	19.830
2532	48.37	1.8516	974027	0.0096	123	8.026E-5	22.478	20.230
2563	48.88	1.8609	974138	0.0190	217	8.759E-5	22.915	20.624
2596	49.40	1.8706	974244	0.0192	203	9.459E-5	23.359	21.024
	49.93	1.8801	974341					
	50.48	1.8898	974442					
2590	51.01	1.8991	974544	0.0191	212	9.010E-5	23.791	21.398
2590	51.57	1.9089	974654	0.0195	220	8.844E-5	23.969	21.572
2590	52.14	1.9186	974764	0.0193	211	9.164E-5	24.141	21.727
2590	52.71	1.9282	974865	0.0097	102	9.536E-5	24.315	21.884
2590	53.30	1.9380	974963	0.0097	100	9.786E-5	24.490	22.041
2590	53.88	1.9476	975056	0.0096	96	1.005E-4	24.668	22.201
2590	54.48	1.9572	975154	0.0096	93	1.028E-4	24.850	22.365
2590	55.11	1.9672	975252	0.0097	92	1.052E-4	25.028	22.525
2590	55.70	1.9765	975337	0.0097	90	1.073E-4	25.214	22.692
2590	56.32	1.9860	975422	0.0097	87	1.103E-4	25.399	22.859
2590	56.97	1.9959	975512	0.0096	84	1.138E-4	25.586	23.027
2590	57.62	2.0056	975597	0.0097	82	1.171E-4	25.778	23.200
2590	58.26	2.0152	975678	0.0097	80	1.215E-4	25.973	23.376
2590	58.94	2.0250	975756	0.0097	77	1.263E-4	26.167	23.550
2590	59.60	2.0345	975829	0.0097	75	1.301E-4	26.369	23.732
2590	60.31	2.0444	975902	0.0097	73	1.334E-4	26.570	23.913
2590	61.01	2.0543	975975	0.0097	71	1.362E-4	26.774	24.097
2590	61.71	2.0637	976045	0.0097	70	1.385E-4	26.985	24.286
2590	62.44	2.0736	976116	0.0097	68	1.422E-4	27.191	24.472
2590	63.17	2.0833	976182	0.0096	65	1.472E-4	27.403	24.663
2590	63.90	2.0928	976247	0.0097	63	1.533E-4	27.617	24.855
2590	64.64	2.1024	976307	0.0097	60	1.602E-4	27.832	25.048
2590	65.40	2.1120	976366	0.0096	58	1.667E-4	28.052	25.247
2590	66.19	2.1218	976423	0.0098	57	1.730E-4	28.278	25.450
2590	67.00	2.1318	976478	0.0098	56	1.770E-4	28.502	25.652
2590	67.78	2.1411	976530	0.0098	54	1.816E-4	28.742	25.867
2590	68.64	2.1514	976586	0.0098	52	1.878E-4	28.972	26.074
2590	69.48	2.1611	976640	0.0097	49	1.965E-4	29.214	26.292

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Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK	
2590	70.32	2.1708	976687	0.0099	48	2.064E-4	29.454	26.508	
2590	71.18	2.1805	976732	0.0098	46	2.150E-4	29.696	26.726	
2590	72.04	2.1901	976774	0.0098	43	2.247E-4	29.950	26.954	
2590	72.98	2.2003	976818	0.0098	41	2.348E-4	30.199	27.178	
2590	73.89	2.2101	976862	0.0099	39	2.493E-4	30.460	27.413	
2590	74.81	2.2198	976900	0.0098	38	2.652E-4	30.717	27.644	
2590	75.74	2.2294	976934	0.0098	36	2.798E-4	30.985	27.885	
2590	76.74	2.2396	976968	0.0098	33	2.984E-4	31.246	28.121	
2590	77.69	2.2491	976999	0.0098	31	3.131E-4	31.524	28.370	
2590	78.69	2.2590	977031	0.0099	30	3.294E-4	31.796	28.615	
2590	79.70	2.2687	977059	0.0098	28	3.474E-4	32.081	28.872	
2590	80.76	2.2789	977088	0.0098	27	3.670E-4	32.362	29.125	
2590	81.80	2.2885	977113	0.0098	25	3.883E-4	32.657	29.389	
2590	82.87	2.2983	977137	0.0098	24	4.079E-4	32.945	29.649	
2590	83.94	2.3080	977161	0.0098	23	4.337E-4	33.247	29.920	
2590	85.08	2.3181	977183	0.0098	21	4.645E-4	33.544	30.188	
2590	86.19	2.3277	977204	0.0098	20	5.063E-4	33.856	30.468	
2590	87.35	2.3376	977223	0.0098	19	5.397E-4	34.167	30.747	
2590	88.54	2.3475	977240	0.0099	18	5.690E-4	34.483	31.031	
2590	89.71	2.3571	977255	0.0099	16	6.036E-4	34.804	31.320	
2590	90.91	2.3669	977272	0.0099	15	6.435E-4	35.144	31.626	
2590	92.27	2.3776	977289	0.0098	15	6.834E-4	35.471	31.920	
2589	93.52	2.3873	977302	0.0098	14	7.174E-4	35.821	32.234	
2590	94.77	2.3968	977314	0.0099	13	7.645E-4	36.158	32.537	
2589	96.07	2.4065	977327	0.0098	12	8.148E-4	36.502	32.846	
2589	97.40	2.4162	977339	0.0099	11	8.709E-4	36.859	33.167	
2589	98.81	2.4264	977350	0.0102	11	9.246E-4	37.224	33.495	
2589	100.27	2.4366	977361	0.0102	11	9.824E-4	37.605	33.835	
2589	101.75	2.4468	977370	0.0103	10	1.055E-3	37.990	34.173	
2586	103.37	2.4580	977381	0.0104	9	1.165E-3	38.390	34.539	
2588	104.77	2.4676	977390	0.0104	8	1.270E-3	38.803	34.900	
2589	106.33	2.4782	977397	0.0104	8	1.373E-3	39.217	35.280	*
2588	107.91	2.4886	977404	0.0102	7	1.486E-3	39.643	35.660	*
2588	109.50	2.4988	977411	0.0105	7	1.603E-3	40.072	36.047	*
2588	111.11	2.5090	977417	0.0104	6	1.689E-3	40.502	36.432	*
2588	112.79	2.5193	977423	0.0103	6	1.841E-3	40.947	36.826	*
2585	114.63	2.5305	977429	0.0104	5	1.985E-3	41.406	37.238	*
2587	116.34	2.5405	977434	0.0105	5	2.134E-3	41.861	37.640	*
2586	118.09	2.5507	977438	0.0106	5	2.282E-3	42.341	38.066	*
2586	119.99	2.5614	977443	0.0108	4	2.502E-3	42.792	38.462	*
2583	121.88	2.5718	977447	0.0106	4	2.769E-3	43.300	38.910	*
2582	123.96	2.5831	977451	0.0106	4	3.039E-3	43.828	39.368	*
2582	126.31	2.5954	977455	0.0105	3	3.519E-3	44.288	39.768	*
2579	128.01	2.6041	977457	0.0106	3	3.624E-3	44.856	40.271	*
2579	130.01	2.6142	977460	0.0104	3	3.956E-3	45.286	40.634	*

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Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK	
2575	132.12	2.6245	977462	0.0103	2	4.271E-3	45.780	41.058	*
2569	134.40	2.6355	977465	0.0209	5	4.171E-3	46.247	41.448	*
2564	136.52	2.6454	977467	0.0216	4	5.391E-3	46.664	41.766	*
	139.07	2.6570	977469						

Automated Fatigue Crack
Growth Rate Analysis

Test ID	5383-FCG-3	Geometry	C(T)
Contract	SSC 10624-01	Orientation	T-L
Material	5383-H116	Yield (ksi)	35.4
Temperature (F)	75	Modulus (Msi)	10.5
Environment	Sea Water		

Specimen Dimensions (in)

Thickness	0.487	Height	2.400
Net Thickness	0.487	Notch Depth	1.000
Width	4.000	Gage Length	0.500

Precrack Parameters

Pmax (lbs)	860.0	Stress Ratio	0.10
Final a (in)	1.050	Kmax (ksi sqr[in])	4.50

Test Parameters

EvBP	Freq	Pmax	R	Ai	Kmaxi	C	DKi
25.056	5.00	0	0.10	1.180	2.40	4.00	0.00
33.659	5.00	0	0.10	1.521	9.37	2.00	0.00
55.211	5.00	2400	0.10	0.000	0.00	0.00	0.00

K Coeff	C Coeff
.886	1.00098
4.64	-4.66951
-13.32	18.4601
14.72	-236.825
-5.6	1214.88
.	-2143.57

Visual Observations

EvB/P	Crack(EvB/P)	Crack(visual)	Error	CAF
20.632	1.024	1.001	-0.023	1.035
21.843	1.085	1.090	0.005	1.031
23.350	1.155	1.170	0.015	1.026
24.006	1.184	1.200	0.016	1.024
26.368	1.281	1.280	-0.001	1.017
29.105	1.382	1.380	-0.002	1.010
33.513	1.522	1.510	-0.012	1.001
46.153	1.824	1.820	-0.004	0.982
54.802	1.975	1.980	0.005	0.973

Comments

Date of test: 9/2/2006
Waveform Type Sine

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Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
	25.54	1.2484	214020					
503	25.67	1.2537	251086	0.0097	76616	1.261E-7	2.996	2.697
510	25.78	1.2581	290636	0.0098	70817	1.382E-7	3.065	2.759
520	25.91	1.2635	321903	0.0048	33533	1.402E-7	3.123	2.811
529	26.03	1.2679	353412	0.0046	31395	1.477E-7	3.183	2.865
536	26.12	1.2716	387345	0.0046	29166	1.568E-7	3.251	2.926
546	26.26	1.2773	415219	0.0046	27833	1.669E-7	3.308	2.977
555	26.37	1.2815	439457	0.0046	25975	1.828E-7	3.377	3.040
564	26.48	1.2858	465633	0.0047	23454	2.002E-7	3.446	3.102
574	26.61	1.2909	488901	0.0046	22039	2.121E-7	3.513	3.162
584	26.74	1.2958	509261	0.0046	20972	2.261E-7	3.584	3.226
594	26.85	1.3000	528067	0.0047	19452	2.413E-7	3.658	3.292
604	26.98	1.3048	547452	0.0047	18288	2.541E-7	3.728	3.355
614	27.10	1.3093	565287	0.0047	17479	2.672E-7	3.804	3.424
625	27.23	1.3142	582346	0.0047	16671	2.840E-7	3.880	3.492
635	27.35	1.3189	598629	0.0047	15405	3.048E-7	3.959	3.563
646	27.48	1.3237	614137	0.0047	14273	3.309E-7	4.039	3.635
657	27.61	1.3283	628095	0.0046	13168	3.615E-7	4.119	3.707
668	27.73	1.3328	639881	0.0046	12026	3.958E-7	4.201	3.781
679	27.86	1.3374	650926	0.0047	10914	4.344E-7	4.284	3.855
691	27.99	1.3421	661352	0.0046	9913	4.752E-7	4.370	3.933
703	28.12	1.3468	670784	0.0046	9127	5.158E-7	4.458	4.013
715	28.25	1.3516	679623	0.0046	8397	5.622E-7	4.547	4.092
727	28.38	1.3562	687570	0.0047	7665	6.158E-7	4.638	4.174
739	28.50	1.3606	694640	0.0046	6993	6.749E-7	4.729	4.256
751	28.63	1.3652	701309	0.0046	6367	7.465E-7	4.822	4.340
764	28.77	1.3700	707343	0.0047	5847	8.215E-7	4.918	4.426
777	28.90	1.3746	712742	0.0047	5457	8.767E-7	5.019	4.517
791	29.04	1.3795	717823	0.0047	5090	9.293E-7	5.121	4.609
805	29.18	1.3843	722653	0.0047	4728	9.881E-7	5.223	4.701
818	29.31	1.3887	727379	0.0047	4377	1.068E-6	5.330	4.797
831	29.45	1.3934	731851	0.0046	4013	1.184E-6	5.434	4.891
846	29.58	1.3982	735713	0.0046	3641	1.340E-6	5.544	4.989
860	29.72	1.4028	739005	0.0046	3240	1.512E-6	5.654	5.088
874	29.86	1.4074	741899	0.0046	2859	1.693E-6	5.766	5.190
889	30.00	1.4120	744501	0.0047	2545	1.889E-6	5.880	5.292
904	30.13	1.4166	746818	0.0047	2292	2.088E-6	5.997	5.398
919	30.28	1.4213	749005	0.0047	2073	2.306E-6	6.118	5.506
935	30.42	1.4262	750984	0.0047	1888	2.538E-6	6.241	5.617
951	30.57	1.4308	752755	0.0047	1736	2.773E-6	6.366	5.729
967	30.71	1.4354	754339	0.0047	1584	3.006E-6	6.495	5.846
984	30.85	1.4401	755826	0.0047	1444	3.269E-6	6.623	5.961
1000	31.00	1.4449	757235	0.0046	1318	3.562E-6	6.757	6.081
1017	31.14	1.4495	758509	0.0046	1219	3.867E-6	6.892	6.203

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
1034	31.29	1.4541	759646	0.0047	1135	4.176E-6	7.025	6.322
1051	31.43	1.4585	760660	0.0046	1042	4.501E-6	7.166	6.449
1069	31.58	1.4632	761652	0.0046	963	4.843E-6	7.308	6.578
1088	31.73	1.4681	762634	0.0047	906	5.180E-6	7.454	6.708
1106	31.88	1.4727	763488	0.0047	858	5.498E-6	7.606	6.845
1124	32.03	1.4773	764286	0.0047	808	5.842E-6	7.757	6.981
1143	32.19	1.4820	765081	0.0047	753	6.234E-6	7.910	7.119
1162	32.34	1.4866	765807	0.0047	709	6.625E-6	8.070	7.263
1182	32.49	1.4914	766498	0.0047	672	7.056E-6	8.232	7.409
1203	32.65	1.4962	767154	0.0047	631	7.517E-6	8.396	7.557
1223	32.80	1.5008	767740	0.0047	591	7.954E-6	8.567	7.711
1244	32.96	1.5055	768316	0.0047	556	8.452E-6	8.738	7.864
1265	33.12	1.5103	768865	0.0092	1036	8.901E-6	8.911	8.020
1286	33.27	1.5147	769352	0.0093	968	9.579E-6	9.092	8.183
	33.44	1.5196	769833					
	33.66	1.5260	770407					
1333	33.77	1.5293	770712	0.0100	927	1.082E-5	9.544	8.590
1346	34.01	1.5360	771334	0.0160	1464	1.096E-5	9.670	8.703
1364	34.33	1.5453	772176	0.0187	1669	1.121E-5	9.835	8.851
1382	34.67	1.5547	773003	0.0090	748	1.204E-5	10.029	9.026
1401	35.01	1.5643	773771	0.0094	758	1.246E-5	10.228	9.205
1420	35.35	1.5738	774485	0.0094	728	1.298E-5	10.431	9.388
1439	35.70	1.5831	775198	0.0094	695	1.352E-5	10.638	9.574
1459	36.05	1.5925	775884	0.0094	668	1.401E-5	10.848	9.763
1478	36.40	1.6019	776543	0.0094	645	1.459E-5	11.063	9.956
1498	36.76	1.6114	777174	0.0094	617	1.524E-5	11.281	10.153
1518	37.12	1.6207	777777	0.0094	590	1.592E-5	11.507	10.356
1539	37.50	1.6303	778354	0.0094	565	1.662E-5	11.731	10.558
1559	37.86	1.6396	778902	0.0094	544	1.732E-5	11.964	10.767
1580	38.23	1.6489	779424	0.0094	523	1.801E-5	12.200	10.980
1601	38.62	1.6583	779933	0.0094	504	1.870E-5	12.442	11.197
1623	39.01	1.6679	780435	0.0094	485	1.942E-5	12.690	11.421
1645	39.40	1.6774	780916	0.0095	467	2.018E-5	12.945	11.650
1667	39.81	1.6869	781375	0.0094	448	2.097E-5	13.200	11.880
1689	40.20	1.6962	781812	0.0094	429	2.180E-5	13.461	12.115
1711	40.61	1.7056	782227	0.0094	411	2.272E-5	13.722	12.350
1733	41.00	1.7147	782619	0.0094	397	2.359E-5	13.991	12.592
1756	41.42	1.7241	783011	0.0094	384	2.456E-5	14.265	12.839
1779	41.84	1.7336	783384	0.0094	367	2.548E-5	14.548	13.093
1803	42.28	1.7432	783758	0.0094	354	2.659E-5	14.840	13.356
1827	42.72	1.7529	784113	0.0095	341	2.783E-5	15.131	13.618
1850	43.14	1.7619	784430	0.0095	329	2.905E-5	15.431	13.888
1874	43.59	1.7713	784743	0.0095	311	3.040E-5	15.737	14.163
1900	44.05	1.7811	785056	0.0094	296	3.184E-5	16.050	14.445
1925	44.53	1.7909	785355	0.0095	286	3.339E-5	16.369	14.732

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
1949	44.98	1.8001	785625	0.0096	271	3.520E-5	16.696	15.027
1975	45.44	1.8094	785887	0.0094	254	3.698E-5	17.027	15.324
2001	45.93	1.8192	786144	0.0093	241	3.894E-5	17.363	15.626
2027	46.42	1.8287	786371	0.0095	233	4.077E-5	17.695	15.926
2051	46.86	1.8372	786581	0.0095	223	4.270E-5	18.048	16.243
2078	47.37	1.8469	786801	0.0095	210	4.482E-5	18.395	16.556
2105	47.89	1.8568	787020	0.0094	201	4.711E-5	18.769	16.892
2133	48.42	1.8667	787222	0.0096	194	4.980E-5	19.144	17.230
2160	48.94	1.8761	787404	0.0096	184	5.258E-5	19.526	17.573
2187	49.45	1.8854	787578	0.0096	172	5.576E-5	19.910	17.919
2215	49.99	1.8950	787744	0.0095	161	5.917E-5	20.304	18.273
2243	50.54	1.9047	787904	0.0095	152	6.315E-5	20.705	18.634
2271	51.09	1.9141	788049	0.0095	142	6.734E-5	21.117	19.005
2300	51.64	1.9236	788185	0.0095	133	7.198E-5	21.533	19.380
2329	52.21	1.9332	788313	0.0095	123	7.751E-5	21.948	19.754
2357	52.76	1.9423	788429	0.0095	114	8.377E-5	22.383	20.145
2386	53.34	1.9518	788540	0.0191	212	9.007E-5	22.815	20.533
2416	53.94	1.9614	788641	0.0190	192	9.914E-5	23.265	20.938
	54.53	1.9709	788732					
	55.21	1.9819	788832					
2400	55.75	1.9907	788930	0.0187	207	9.056E-5	23.642	21.276
2400	56.37	2.0007	789039	0.0204	219	9.324E-5	23.817	21.435
2400	57.03	2.0111	789149	0.0205	212	9.650E-5	24.002	21.601
2400	57.67	2.0211	789251	0.0102	103	9.869E-5	24.196	21.776
2400	58.34	2.0315	789353	0.0102	100	1.016E-4	24.388	21.949
2400	59.02	2.0418	789454	0.0101	97	1.042E-4	24.584	22.126
2400	59.70	2.0519	789548	0.0102	95	1.070E-4	24.780	22.302
2400	60.37	2.0617	789637	0.0101	91	1.101E-4	24.980	22.482
2400	61.07	2.0718	789731	0.0101	88	1.140E-4	25.182	22.664
2400	61.81	2.0823	789820	0.0100	85	1.176E-4	25.385	22.847
2400	62.51	2.0922	789901	0.0101	83	1.212E-4	25.597	23.038
2400	63.25	2.1024	789983	0.0101	81	1.252E-4	25.802	23.222
2400	63.97	2.1121	790060	0.0100	79	1.277E-4	26.015	23.414
2400	64.72	2.1221	790136	0.0100	77	1.296E-4	26.232	23.609
2400	65.52	2.1326	790216	0.0100	75	1.321E-4	26.448	23.803
2400	66.29	2.1425	790291	0.0101	74	1.348E-4	26.672	24.005
2400	67.07	2.1524	790365	0.0101	73	1.378E-4	26.894	24.205
2400	67.87	2.1624	790435	0.0101	71	1.417E-4	27.121	24.409
2400	68.70	2.1725	790505	0.0102	69	1.460E-4	27.355	24.619
2400	69.55	2.1828	790575	0.0102	67	1.520E-4	27.593	24.833
2400	70.41	2.1931	790642	0.0102	64	1.595E-4	27.836	25.052
2400	71.29	2.2034	790707	0.0101	61	1.679E-4	28.083	25.275
2400	72.19	2.2136	790764	0.0101	58	1.767E-4	28.330	25.496
2400	73.07	2.2236	790817	0.0101	55	1.845E-4	28.578	25.720
2400	73.95	2.2333	790870	0.0100	52	1.910E-4	28.831	25.948

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Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK	
2400	74.90	2.2436	790921	0.0100	52	1.949E-4	29.083	26.175	
2400	75.83	2.2535	790971	0.0101	50	1.992E-4	29.344	26.409	
2400	76.76	2.2634	791021	0.0101	48	2.065E-4	29.612	26.650	
2400	77.77	2.2738	791073	0.0101	47	2.162E-4	29.880	26.892	
2400	78.79	2.2841	791119	0.0102	45	2.304E-4	30.156	27.140	
2400	79.78	2.2939	791159	0.0103	42	2.470E-4	30.436	27.392	
2400	80.83	2.3042	791201	0.0102	39	2.656E-4	30.728	27.654	
2400	81.94	2.3149	791239	0.0101	36	2.831E-4	31.016	27.915	
2400	83.03	2.3251	791273	0.0102	34	3.016E-4	31.315	28.182	
2400	84.09	2.3349	791305	0.0102	32	3.218E-4	31.604	28.443	
2400	85.13	2.3444	791334	0.0101	30	3.387E-4	31.910	28.718	
2400	86.34	2.3552	791364	0.0099	28	3.538E-4	32.213	28.991	
2400	87.54	2.3656	791392	0.0101	27	3.698E-4	32.533	29.278	
2400	88.69	2.3755	791418	0.0101	26	3.849E-4	32.842	29.557	
2400	89.80	2.3848	791443	0.0100	25	3.999E-4	33.165	29.847	
2400	91.06	2.3952	791468	0.0100	24	4.195E-4	33.479	30.130	
2400	92.31	2.4053	791491	0.0101	23	4.415E-4	33.818	30.435	
2400	93.59	2.4154	791514	0.0103	22	4.665E-4	34.159	30.741	
2400	94.90	2.4257	791535	0.0102	21	4.900E-4	34.513	31.060	
2400	96.30	2.4363	791556	0.0101	20	5.180E-4	34.866	31.378	
2400	97.65	2.4464	791575	0.0101	18	5.504E-4	35.232	31.707	
2400	99.02	2.4564	791593	0.0101	17	5.963E-4	35.586	32.025	
2400	100.37	2.4661	791609	0.0101	16	6.434E-4	35.950	32.352	
2400	101.77	2.4759	791624	0.0100	15	6.871E-4	36.318	32.683	
2400	103.25	2.4861	791637	0.0101	14	7.346E-4	36.704	33.030	
2400	104.81	2.4966	791651	0.0102	13	7.867E-4	37.087	33.374	
2399	106.30	2.5064	791664	0.0102	12	8.499E-4	37.508	33.753	
2400	107.97	2.5172	791676	0.0107	12	9.410E-4	37.904	34.107	
2399	109.57	2.5274	791687	0.0102	10	1.031E-3	38.327	34.486	*
2399	111.19	2.5374	791696	0.0102	9	1.119E-3	38.808	34.914	*
2400	113.30	2.5502	791706	0.0100	9	1.217E-3	39.177	35.250	*
2400	114.60	2.5578	791713	0.0101	8	1.291E-3	39.669	35.689	*
2399	116.29	2.5676	791720	0.0101	8	1.346E-3	40.050	36.037	*
2399	118.03	2.5775	791727	0.0097	7	1.402E-3	40.503	36.448	*
2400	119.92	2.5879	791734	0.0102	7	1.456E-3	40.952	36.848	*
2399	121.76	2.5979	791741	0.0103	7	1.518E-3	41.433	37.279	*
2399	123.70	2.6082	791748	0.0104	6	1.633E-3	41.918	37.711	*
2398	125.79	2.6190	791755	0.0103	6	1.773E-3	42.423	38.161	*
2399	127.89	2.6296	791760	0.0103	6	1.932E-3	42.933	38.616	*
2398	129.96	2.6399	791765	0.0104	5	2.122E-3	43.454	39.087	*
2399	131.99	2.6496	791770	0.0104	5	2.315E-3	43.966	39.537	*
2398	134.17	2.6599	791774	0.0105	4	2.545E-3	44.502	40.019	*
2397	136.51	2.6706	791778	0.0104	4	2.814E-3	45.051	40.503	*
2397	138.90	2.6813	791782	0.0106	3	3.270E-3	45.620	41.010	*
2395	141.47	2.6925	791785	0.0119	3	4.179E-3	46.087	41.403	*

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Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK	
2383	143.82	2.7025	791788	0.0129	3	4.988E-3	46.684	41.931	*
2384	146.36	2.7131	791790	0.0286	4	7.155E-3	47.305	42.443	*
2375	150.87	2.7312	791792	0.0349	5	6.974E-3	47.886	42.911	*
	155.25	2.7479	791795						

Automated Fatigue Crack
Growth Rate Analysis

Test ID	5383-FCG-45	Geometry	C(T)
Contract	SSC 10624-01	Orientation	T-L
Material	5383-H116	Yield (ksi)	35.4
Temperature (F)	75	Modulus (Msi)	10.5
Environment	RH = 40%		

Specimen Dimensions (in)

Thickness	0.486	Height	2.400
Net Thickness	0.486	Notch Depth	1.000
Width	4.002	Gage Length	0.500

Precrack Parameters

Pmax (lbs)	859.0	Stress Ratio	0.10
Final a (in)	1.050	Kmax (ksi sqr[in])	4.50

Test Parameters

EvBP	Freq	Pmax	R	Ai	Kmaxi	C	DKi
23.789	5.00	0	0.10	1.140	3.10	4.00	0.00
30.408	5.00	0	0.10	1.416	9.34	2.00	0.00
48.973	5.00	2575	0.10	0.000	0.00	0.00	0.00

K Coeff	C Coeff
.886	1.00098
4.64	-4.66951
-13.32	18.4601
14.72	-236.825
-5.6	1214.88
.	-2143.57

Visual Observations

EvB/P	Crack(EvB/P)	Crack(visual)	Error	CAF
20.753	0.983	1.002	0.019	0.993
21.841	1.041	1.040	-0.001	0.991
23.480	1.121	1.100	-0.021	0.989
23.760	1.134	1.170	0.036	0.989
26.667	1.260	1.260	0.000	0.986
27.531	1.294	1.280	-0.014	0.985
30.339	1.397	1.380	-0.017	0.983
34.274	1.523	1.490	-0.033	0.980
48.661	1.865	1.880	0.015	0.972
59.300	2.043	2.080	0.037	0.969
66.619	2.142	2.120	-0.022	0.966
101.006	2.462	2.460	-0.002	0.959

Comments

Date of test: 9/17/2006

Waveform Type Sine

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Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
	23.88	1.1397	98879					
592	23.99	1.1451	149517	0.0100	95897	1.043E-7	3.295	2.966
601	24.10	1.1497	194776	0.0102	80660	1.269E-7	3.370	3.033
613	24.22	1.1554	230177	0.0051	36339	1.477E-7	3.435	3.091
623	24.32	1.1601	262838	0.0049	31739	1.654E-7	3.508	3.158
633	24.43	1.1650	290853	0.0050	27100	1.889E-7	3.580	3.222
644	24.55	1.1701	316914	0.0048	24356	2.097E-7	3.649	3.284
654	24.65	1.1748	339948	0.0049	21817	2.344E-7	3.725	3.352
666	24.77	1.1798	357374	0.0049	19901	2.505E-7	3.795	3.415
676	24.87	1.1844	376314	0.0049	18184	2.714E-7	3.874	3.487
688	24.99	1.1896	393740	0.0049	16568	2.941E-7	3.948	3.553
699	25.09	1.1941	410257	0.0049	15684	3.184E-7	4.031	3.628
711	25.21	1.1994	426017	0.0050	14224	3.586E-7	4.113	3.701
724	25.33	1.2044	439353	0.0049	12936	3.988E-7	4.195	3.776
736	25.44	1.2093	451477	0.0049	11685	4.385E-7	4.285	3.856
749	25.56	1.2143	461659	0.0049	10480	4.783E-7	4.368	3.931
761	25.67	1.2191	471354	0.0049	9615	5.147E-7	4.457	4.011
774	25.78	1.2237	480369	0.0049	8757	5.580E-7	4.547	4.093
788	25.91	1.2289	488898	0.0048	8082	6.017E-7	4.636	4.172
801	26.02	1.2336	497041	0.0049	7501	6.660E-7	4.731	4.258
814	26.14	1.2387	504019	0.0049	6919	7.224E-7	4.822	4.340
827	26.25	1.2431	510148	0.0049	6326	7.842E-7	4.924	4.432
842	26.38	1.2486	516358	0.0100	11736	8.521E-7	5.017	4.516
856	26.49	1.2531	521884	0.0095	10496	9.030E-7	5.124	4.612
870	26.62	1.2580	526854	0.0450	31113	1.446E-6	0.000	0.000
999	27.63	1.2980	552997	0.0442	27932	1.581E-6	0.000	0.000
1013	27.73	1.3022	554786	0.0089	3659	2.434E-6	6.265	5.638
1030	27.86	1.3069	556656	0.0095	3577	2.662E-6	6.379	5.741
1047	27.98	1.3117	558363	0.0098	3333	2.933E-6	6.507	5.856
1065	28.11	1.3167	559989	0.0049	1561	3.203E-6	6.638	5.974
1083	28.25	1.3218	561534	0.0050	1434	3.517E-6	6.775	6.098
1102	28.38	1.3268	562916	0.0050	1315	3.859E-6	6.914	6.223
1121	28.51	1.3318	564152	0.0049	1199	4.225E-6	7.057	6.351
1140	28.65	1.3367	565260	0.0049	1088	4.617E-6	7.197	6.477
1159	28.78	1.3415	566255	0.0049	989	5.011E-6	7.343	6.609
1179	28.91	1.3463	567184	0.0049	907	5.431E-6	7.489	6.740
1199	29.04	1.3513	568059	0.0049	840	5.864E-6	7.638	6.874
1219	29.17	1.3561	568851	0.0049	786	6.289E-6	7.794	7.015
1240	29.31	1.3610	569595	0.0049	737	6.695E-6	7.948	7.153
1261	29.45	1.3659	570299	0.0049	687	7.160E-6	8.110	7.299
1282	29.59	1.3709	570970	0.0049	640	7.651E-6	8.273	7.445
1304	29.72	1.3757	571607	0.0049	599	8.187E-6	8.442	7.598
1326	29.86	1.3807	572178	0.0049	563	8.718E-6	8.606	7.745
1347	30.00	1.3853	572690	0.0094	1010	9.343E-6	8.781	7.903

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
1370	30.13	1.3902	573188	0.0097	989	9.839E-6	8.952	8.057
	30.27	1.3951	573679					
	34.37	1.5263	581958					
1699	34.66	1.5348	582335	0.0183	857	2.135E-5	12.199	10.979
1722	34.99	1.5446	582815	0.0196	950	2.067E-5	12.426	11.183
1744	35.33	1.5544	583285	0.0198	919	2.153E-5	12.676	11.408
1768	35.69	1.5644	583734	0.0099	443	2.234E-5	12.930	11.637
1792	36.04	1.5744	584171	0.0099	426	2.320E-5	13.192	11.873
1817	36.40	1.5845	584596	0.0099	410	2.414E-5	13.457	12.112
1841	36.76	1.5942	584990	0.0099	396	2.495E-5	13.727	12.354
1865	37.11	1.6039	585368	0.0098	378	2.593E-5	14.004	12.604
1891	37.49	1.6140	585746	0.0098	362	2.698E-5	14.281	12.853
1916	37.86	1.6237	586109	0.0099	352	2.812E-5	14.569	13.112
1941	38.23	1.6335	586439	0.0099	339	2.929E-5	14.859	13.373
1967	38.61	1.6433	586770	0.0098	323	3.052E-5	15.163	13.646
1995	39.02	1.6537	587101	0.0099	309	3.195E-5	15.467	13.920
2021	39.41	1.6636	587400	0.0099	298	3.323E-5	15.780	14.202
2048	39.79	1.6730	587682	0.0099	285	3.467E-5	16.100	14.490
2075	40.20	1.6831	587961	0.0098	270	3.631E-5	16.417	14.775
2103	40.61	1.6929	588228	0.0098	258	3.806E-5	16.750	15.075
2130	41.02	1.7028	588482	0.0099	247	3.998E-5	17.085	15.377
2159	41.44	1.7128	588723	0.0098	234	4.194E-5	17.430	15.687
2188	41.86	1.7226	588950	0.0098	222	4.417E-5	17.777	15.999
2216	42.29	1.7323	589163	0.0098	211	4.649E-5	18.128	16.316
2244	42.71	1.7418	589366	0.0098	201	4.896E-5	18.486	16.638
2273	43.14	1.7517	589559	0.0098	189	5.176E-5	18.856	16.971
2304	43.60	1.7617	589748	0.0098	179	5.505E-5	19.235	17.311
2334	44.06	1.7717	589927	0.0099	169	5.879E-5	19.616	17.654
2363	44.50	1.7812	590082	0.0099	159	6.258E-5	20.014	18.013
2395	44.96	1.7911	590234	0.0099	148	6.710E-5	20.408	18.367
2426	45.44	1.8011	590379	0.0099	138	7.229E-5	20.815	18.734
2457	45.91	1.8109	590511	0.0099	130	7.734E-5	21.241	19.117
2489	46.41	1.8211	590637	0.0099	121	8.271E-5	21.667	19.500
2522	46.90	1.8310	590752	0.0099	113	8.836E-5	22.103	19.892
2554	47.39	1.8407	590859	0.0195	209	9.346E-5	22.548	20.293
2587	47.89	1.8506	590961	0.0199	198	1.003E-4	22.995	20.696
	48.41	1.8606	591057					
	48.97	1.8713	591167					
2575	49.45	1.8803	591269	0.0190	211	8.982E-5	23.393	21.054
2575	49.99	1.8902	591378	0.0198	215	9.223E-5	23.554	21.199
2575	50.53	1.9001	591484	0.0197	208	9.493E-5	23.726	21.353
2575	51.08	1.9100	591586	0.0099	99	9.993E-5	23.898	21.508
2575	51.63	1.9197	591679	0.0098	95	1.038E-4	24.073	21.666
2575	52.20	1.9297	591773	0.0099	92	1.073E-4	24.249	21.824
2575	52.77	1.9396	591862	0.0099	90	1.103E-4	24.427	21.984

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Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK	
2575	53.34	1.9493	591947	0.0099	87	1.125E-4	24.609	22.148	
2575	53.93	1.9592	592037	0.0099	85	1.157E-4	24.792	22.313	
2575	54.54	1.9693	592123	0.0100	83	1.194E-4	24.977	22.480	
2575	55.14	1.9790	592203	0.0100	81	1.236E-4	25.171	22.654	
2575	55.78	1.9893	592285	0.0099	77	1.289E-4	25.364	22.828	
2575	56.44	1.9997	592362	0.0099	74	1.338E-4	25.557	23.001	
2575	57.04	2.0091	592430	0.0099	71	1.387E-4	25.756	23.180	
2575	57.68	2.0188	592500	0.0194	136	1.427E-4	25.947	23.352	
2575	58.32	2.0285	592566	0.0197	131	1.504E-4	26.148	23.533	
2575	59.00	2.0385	592631	0.1208	649	1.862E-4	0.000	0.000	
2575	67.20	2.1493	593215	0.1291	660	1.956E-4	0.000	0.000	
2575	68.71	2.1676	593291	0.0281	114	2.468E-4	29.161	26.243	
2575	69.53	2.1775	593329	0.0199	76	2.613E-4	29.511	26.560	
2575	70.39	2.1875	593367	0.0198	75	2.642E-4	29.760	26.784	
2575	71.24	2.1973	593404	0.0099	37	2.699E-4	30.020	27.017	
2575	72.16	2.2076	593442	0.0100	35	2.805E-4	30.276	27.248	
2575	73.06	2.2176	593478	0.0101	34	2.963E-4	30.539	27.485	
2575	73.94	2.2272	593510	0.0101	33	3.121E-4	30.810	27.728	
2575	74.90	2.2375	593541	0.0100	30	3.343E-4	31.083	27.974	
2575	75.89	2.2480	593571	0.0100	28	3.560E-4	31.359	28.222	
2575	76.83	2.2578	593599	0.0100	27	3.710E-4	31.640	28.475	
2575	77.78	2.2674	593622	0.0099	26	3.820E-4	31.921	28.728	
2575	78.78	2.2773	593647	0.0100	25	3.982E-4	32.202	28.980	
2575	79.78	2.2872	593673	0.0100	24	4.137E-4	32.491	29.242	
2575	80.80	2.2970	593697	0.0100	24	4.265E-4	32.797	29.516	
2575	81.93	2.3077	593720	0.0100	23	4.477E-4	33.092	29.782	
2575	82.98	2.3175	593742	0.0100	21	4.736E-4	33.413	30.070	
2575	84.10	2.3277	593763	0.0101	20	5.006E-4	33.718	30.345	
2575	85.19	2.3375	593782	0.0099	19	5.308E-4	34.035	30.630	
2575	86.31	2.3473	593800	0.0099	17	5.741E-4	34.362	30.924	
2575	87.52	2.3578	593818	0.0099	16	6.301E-4	34.678	31.208	
2575	88.65	2.3674	593833	0.0100	15	6.825E-4	35.010	31.507	
2575	89.80	2.3769	593846	0.0100	14	7.337E-4	35.349	31.812	
2575	91.07	2.3873	593859	0.0099	13	7.798E-4	35.688	32.117	
2575	92.36	2.3976	593872	0.0100	12	8.232E-4	36.037	32.430	
2575	93.58	2.4071	593883	0.0101	12	8.526E-4	36.398	32.755	
2575	94.89	2.4172	593895	0.0101	12	8.796E-4	36.754	33.075	
2575	96.25	2.4275	593906	0.0100	11	9.133E-4	37.128	33.411	
2575	97.64	2.4377	593917	0.0105	11	9.704E-4	37.507	33.752	
2575	99.03	2.4478	593928	0.0102	10	1.028E-3	37.884	34.091	
2574	100.38	2.4574	593937	0.0103	10	1.093E-3	38.320	34.476	
2574	102.16	2.4699	593947	0.0102	9	1.182E-3	38.681	34.806	
2575	103.40	2.4785	593955	0.0102	8	1.253E-3	39.148	35.222	*
2574	105.02	2.4895	593963	0.0103	8	1.345E-3	39.522	35.562	*
2574	106.48	2.4991	593970	0.0100	7	1.445E-3	39.954	35.953	*

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK	
2575	107.99	2.5089	593977	0.0103	7	1.552E-3	40.371	36.323	*
2574	109.62	2.5193	593983	0.0101	6	1.654E-3	40.814	36.721	*
2574	111.32	2.5298	593989	0.0102	6	1.810E-3	41.261	37.121	*
2574	113.00	2.5401	593995	0.0103	5	1.942E-3	41.722	37.534	*
2574	114.72	2.5503	594000	0.0103	5	2.097E-3	42.182	37.945	*
2574	116.41	2.5602	594004	0.0105	5	2.191E-3	42.653	38.366	*
2574	118.22	2.5704	594009	0.0104	4	2.384E-3	43.147	38.809	*
2574	120.16	2.5813	594013	0.0103	4	2.538E-3	43.660	39.267	*
2573	122.25	2.5926	594018	0.0103	4	2.806E-3	44.162	39.715	*
2572	124.12	2.6026	594021	0.0105	4	3.032E-3	44.680	40.178	*
2573	125.91	2.6118	594024	0.0107	3	3.289E-3	45.169	40.608	*
2571	127.90	2.6220	594027	0.0107	3	3.706E-3	45.683	41.062	*
2568	130.18	2.6333	594030	0.0106	3	4.402E-3	46.204	41.509	*
2560	132.74	2.6456	594033	0.0107	2	5.107E-3	46.800	42.032	*
2563	135.08	2.6566	594035	0.0109	2	6.174E-3	47.313	42.472	*
2560	137.14	2.6661	594036	0.0106	2	6.856E-3	47.891	42.976	*
2556	139.37	2.6761	594038	0.0101	1	8.108E-3	48.307	43.322	*
2540	141.95	2.6873	594039	0.0207	2	1.033E-2	48.759	43.700	*
2532	144.15	2.6967	594040	0.0191	2	9.541E-3	49.066	43.917	*
	146.48	2.7064	594041						

Automated Fatigue Crack
Growth Rate Analysis

Test ID	5383-FCG-4pt5	Geometry	C(T)
Contract	SSC 10624-01	Orientation	T-L
Material	5383-H116	Yield (ksi)	35.4
Temperature (F)	75	Modulus (Msi)	10.5
Environment	RH = 40%		

Specimen Dimensions (in)

Thickness	0.486	Height	2.400
Net Thickness	0.486	Notch Depth	1.000
Width	4.002	Gage Length	0.500

Precrack Parameters

Pmax (lbs)	859.0	Stress Ratio	0.10
Final a (in)	1.050	Kmax (ksi sqr[in])	4.50

Test Parameters

EvBP	Freq	Pmax	R	Ai	Kmaxi	C	DKi
23.789	0.50	0	0.10	1.140	3.10	4.00	0.00
30.408	0.50	0	0.10	1.416	9.34	2.00	0.00
48.973	0.50	2575	0.10	0.000	0.00	0.00	0.00

K Coeff	C Coeff
.886	1.00098
4.64	-4.66951
-13.32	18.4601
14.72	-236.825
-5.6	1214.88
.	-2143.57

Visual Observations

EvB/P	Crack(EvB/P)	Crack(visual)	Error	CAF
20.753	0.983	1.002	0.019	0.993
21.841	1.041	1.040	-0.001	0.991
23.480	1.121	1.100	-0.021	0.989
23.760	1.134	1.170	0.036	0.989
26.667	1.260	1.260	0.000	0.986
27.531	1.294	1.280	-0.014	0.985
30.339	1.397	1.380	-0.017	0.983
34.274	1.523	1.490	-0.033	0.980
48.661	1.865	1.880	0.015	0.972
59.300	2.043	2.080	0.037	0.969
66.619	2.142	2.120	-0.022	0.966
101.006	2.462	2.460	-0.002	0.959

Comments

Date of test: 9/17/2006

Waveform Type Sine

Test ID 5383-FCG-4pt5 Page 1

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
	26.74	1.2630	529674					
890	26.77	1.2641	530731	0.0031	2723	1.140E-6	5.370	4.833
896	26.81	1.2661	532397	0.0040	3305	1.196E-6	5.405	4.865
902	26.86	1.2680	534036	0.0018	1489	1.232E-6	5.449	4.904
908	26.91	1.2701	535687	0.0020	1546	1.266E-6	5.492	4.943
914	26.96	1.2720	537212	0.0020	1512	1.305E-6	5.536	4.983
920	27.01	1.2739	538610	0.0020	1482	1.337E-6	5.580	5.022
927	27.06	1.2759	540007	0.0020	1440	1.372E-6	5.625	5.063
933	27.11	1.2779	541468	0.0020	1398	1.407E-6	5.671	5.104
939	27.16	1.2799	542928	0.0020	1353	1.449E-6	5.717	5.146
946	27.21	1.2819	544325	0.0020	1306	1.518E-6	5.764	5.188
952	27.26	1.2839	545597	0.0020	1241	1.596E-6	5.810	5.229
959	27.31	1.2858	546727	0.0019	1184	1.657E-6	5.858	5.272
965	27.36	1.2878	547845	0.0020	1137	1.724E-6	5.903	5.313
971	27.41	1.2896	548912	0.0038	2185	1.744E-6	5.950	5.355
978	27.46	1.2916	550030	0.0040	2235	1.809E-6	5.998	5.399
985	27.51	1.2937	551147	0.1081	23998	4.504E-6	0.000	0.000
1410	30.41	1.3997	574028	0.1074	22994	4.672E-6	0.000	0.000
1413	30.45	1.4011	574141	0.0035	264	1.315E-5	9.300	8.370
1417	30.51	1.4031	574292	0.0041	318	1.283E-5	9.333	8.399
1421	30.57	1.4052	574459	0.0040	332	1.219E-5	9.371	8.434
1425	30.63	1.4072	574624	0.0020	153	1.289E-5	9.409	8.468
1429	30.68	1.4091	574769	0.0020	153	1.289E-5	9.446	8.501
1432	30.74	1.4110	574908	0.0020	151	1.304E-5	9.484	8.535
1436	30.80	1.4131	575060	0.0020	148	1.320E-5	9.520	8.568
1440	30.86	1.4149	575212	0.0020	148	1.324E-5	9.559	8.603
1444	30.91	1.4169	575364	0.0020	149	1.322E-5	9.596	8.637
1448	30.97	1.4189	575509	0.0020	147	1.335E-5	9.636	8.672
1452	31.03	1.4210	575655	0.0020	144	1.356E-5	9.674	8.706
1456	31.09	1.4228	575800	0.0020	140	1.381E-5	9.713	8.741
1460	31.15	1.4248	575939	0.0020	138	1.405E-5	9.750	8.775
1464	31.20	1.4267	576077	0.0019	137	1.428E-5	9.788	8.810
1468	31.26	1.4286	576203	0.0020	134	1.459E-5	9.828	8.845
1472	31.32	1.4306	576339	0.0020	133	1.476E-5	9.867	8.880
1476	31.38	1.4326	576476	0.0020	132	1.494E-5	9.907	8.916
1480	31.44	1.4346	576603	0.0020	133	1.493E-5	9.946	8.951
1484	31.50	1.4365	576735	0.0020	130	1.502E-5	9.986	8.988
1488	31.56	1.4385	576867	0.0019	128	1.513E-5	10.026	9.024
1492	31.62	1.4405	576999	0.0020	127	1.533E-5	10.065	9.059
1496	31.68	1.4424	577121	0.0019	125	1.549E-5	10.105	9.095
1500	31.74	1.4443	577243	0.0019	125	1.566E-5	10.145	9.131
1504	31.80	1.4463	577365	0.0019	125	1.577E-5	10.183	9.165
1508	31.85	1.4481	577482	0.0020	125	1.576E-5	10.226	9.203
1512	31.92	1.4502	577614	0.0020	124	1.576E-5	10.265	9.238

Test ID 5383-FCG-4pt5 Page 2

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
1516	31.98	1.4521	577746	0.0019	121	1.575E-5	10.308	9.277
1520	32.04	1.4542	577873	0.0040	239	1.672E-5	10.348	9.313
1524	32.10	1.4561	577985	0.0036	215	1.666E-5	10.387	9.348
1528	32.15	1.4578	578088	0.5905	14701	4.017E-5	0.000	0.000
2574	59.55	2.0466	592686	0.5907	14611	4.043E-5	0.000	0.000
2575	59.67	2.0485	592699	0.0038	27	1.409E-4	26.554	23.896
2575	59.81	2.0504	592713	0.0038	26	1.452E-4	26.595	23.935
2575	59.93	2.0522	592725	0.0039	26	1.505E-4	26.638	23.974
2575	60.08	2.0544	592739	0.0019	13	1.514E-4	26.676	24.009
2575	60.21	2.0562	592751	0.0019	12	1.539E-4	26.717	24.046
2575	60.33	2.0579	592762	0.0019	12	1.537E-4	26.757	24.081
2575	60.46	2.0599	592774	0.0019	12	1.556E-4	26.796	24.117
2575	60.60	2.0618	592787	0.0019	12	1.585E-4	26.836	24.152
2575	60.73	2.0636	592799	0.0019	12	1.628E-4	26.878	24.191
2575	60.86	2.0655	592811	0.0020	12	1.674E-4	26.919	24.227
2575	61.01	2.0676	592822	0.0020	12	1.720E-4	26.962	24.265
2575	61.15	2.0696	592833	0.0020	12	1.755E-4	27.005	24.305
2575	61.30	2.0716	592845	0.0020	12	1.754E-4	27.049	24.344
2575	61.44	2.0737	592857	0.0020	12	1.719E-4	27.093	24.384
2575	61.59	2.0757	592868	0.0020	12	1.700E-4	27.136	24.422
2575	61.72	2.0776	592880	0.0020	12	1.703E-4	27.178	24.460
2575	61.86	2.0795	592891	0.0020	12	1.699E-4	27.221	24.499
2575	62.01	2.0815	592903	0.0020	12	1.690E-4	27.265	24.539
2575	62.16	2.0837	592916	0.0020	12	1.706E-4	27.309	24.578
2575	62.31	2.0856	592927	0.0020	12	1.714E-4	27.354	24.618
2575	62.44	2.0875	592938	0.0039	23	1.687E-4	27.397	24.657
2575	62.59	2.0895	592950	0.0042	24	1.738E-4	27.442	24.698
	62.75	2.0917	592962					

Automated Fatigue Crack
Growth Rate Analysis

Test ID	5383-FCG-4pt05	Geometry	C(T)
Contract	SSC 10624-01	Orientation	T-L
Material	5383-H116	Yield (ksi)	35.4
Temperature (F)	75	Modulus (Msi)	10.5
Environment	RH = 40%		

Specimen Dimensions (in)

Thickness	0.486	Height	2.400
Net Thickness	0.486	Notch Depth	1.000
Width	4.002	Gage Length	0.500

Precrack Parameters

Pmax (lbs)	859.0	Stress Ratio	0.10
Final a (in)	1.050	Kmax (ksi sqr[in])	4.50

Test Parameters

EvBP	Freq	Pmax	R	Ai	Kmaxi	C	DKi
30.410	0.05	0	0.10	1.416	9.34	2.00	0.00
48.970	0.05	2575	0.10	0.000	0.00	0.00	0.00

K Coeff	C Coeff
.886	1.00098
4.64	-4.66951
-13.32	18.4601
14.72	-236.825
-5.6	1214.88
.	-2143.57

Visual Observations

EvB/P	Crack(EvB/P)	Crack(visual)	Error	CAF
20.753	0.983	1.002	0.019	0.993
21.841	1.041	1.040	-0.001	0.991
23.480	1.121	1.100	-0.021	0.989
23.760	1.134	1.170	0.036	0.989
26.667	1.260	1.260	0.000	0.986
27.531	1.294	1.280	-0.014	0.985
30.339	1.397	1.380	-0.017	0.983
34.274	1.523	1.490	-0.033	0.980
48.661	1.865	1.880	0.015	0.972
59.300	2.043	2.080	0.037	0.969
66.619	2.142	2.120	-0.022	0.966
101.006	2.462	2.460	-0.002	0.959

Comments

Date of test: 9/18/2006	
Waveform Type	Sine

Test ID 5383-FCG-4pt05 Page 1

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
	32.28	1.4618	578265					
1541	32.34	1.4638	578397	0.0040	278	1.430E-5	10.553	9.498
1545	32.40	1.4658	578543	0.0042	298	1.397E-5	10.597	9.538
1550	32.47	1.4679	578695	0.0020	142	1.408E-5	10.640	9.576
1554	32.53	1.4699	578827	0.0020	142	1.396E-5	10.683	9.614
1558	32.59	1.4717	578965	0.0020	139	1.394E-5	10.726	9.653
1562	32.65	1.4737	579117	0.0019	138	1.401E-5	10.767	9.690
1566	32.72	1.4757	579249	0.0037	259	1.441E-5	10.809	9.728
1570	32.77	1.4775	579376	0.0038	275	1.391E-5	10.853	9.768
1575	32.84	1.4796	579524	0.6184	13601	4.547E-5	0.000	0.000
2574	63.06	2.0958	592977	0.6178	13461	4.590E-5	0.000	0.000
2575	63.17	2.0974	592985	0.0036	19	1.884E-4	27.617	24.858
2575	63.32	2.0994	592996	0.0041	22	1.875E-4	27.660	24.894
2575	63.48	2.1015	593007	0.0040	21	1.901E-4	27.705	24.934
2575	63.62	2.1034	593017	0.0020	10	1.989E-4	27.751	24.976
2575	63.77	2.1053	593026	0.0020	10	2.043E-4	27.795	25.015
2575	63.93	2.1074	593036	0.0020	10	2.094E-4	27.841	25.058
2575	64.08	2.1095	593046	0.0020	9	2.135E-4	27.887	25.099
2575	64.23	2.1115	593055	0.0020	10	2.117E-4	27.933	25.140
2575	64.38	2.1134	593064	0.0020	10	2.111E-4	27.978	25.181
2575	64.53	2.1154	593073	0.0020	9	2.114E-4	28.022	25.220
2575	64.68	2.1173	593083	0.0020	9	2.104E-4	28.069	25.262
2575	64.84	2.1194	593093	0.0020	9	2.134E-4	28.114	25.303
2575	65.00	2.1214	593102	0.0020	9	2.182E-4	28.160	25.345
2575	65.15	2.1234	593111	0.0020	9	2.262E-4	28.209	25.388
2575	65.31	2.1255	593120	0.0020	9	2.342E-4	28.253	25.428
2575	65.46	2.1274	593128	0.0020	8	2.396E-4	28.301	25.471
2575	65.61	2.1293	593136	0.0020	8	2.450E-4	28.347	25.512
2575	65.77	2.1314	593144	0.0020	8	2.514E-4	28.393	25.554
2575	65.93	2.1334	593152	0.0020	8	2.548E-4	28.440	25.596
2575	66.08	2.1354	593160	0.0020	8	2.579E-4	28.488	25.639
2575	66.25	2.1374	593167	0.0040	15	2.652E-4	28.534	25.680
2575	66.40	2.1393	593175	0.0039	15	2.572E-4	28.581	25.723
	66.55	2.1412	593182					

Automated Fatigue Crack
Growth Rate Analysis

Test ID	5383-FCG-4Cpt05	Geometry	C(T)
Contract	SSC 10624-01	Orientation	T-L
Material	5383-H116	Yield (ksi)	35.4
Temperature (F)	75	Modulus (Msi)	10.5
Environment	RH = 40%		

Specimen Dimensions (in)

Thickness	0.486	Height	2.400
Net Thickness	0.486	Notch Depth	1.000
Width	4.002	Gage Length	0.500

Precrack Parameters

Pmax (lbs)	859.0	Stress Ratio	0.10
Final a (in)	1.050	Kmax (ksi sqr[in])	4.50

Test Parameters

EvBP	Freq	Pmax	R	Ai	Kmaxi	C	DKi
30.410	0.05	0	0.10	1.416	9.34	2.00	0.00

K Coeff	C Coeff
.886	1.00098
4.64	-4.66951
-13.32	18.4601
14.72	-236.825
-5.6	1214.88
.	-2143.57

Visual Observations

EvB/P	Crack(EvB/P)	Crack(visual)	Error	CAF
20.753	0.983	1.002	0.019	0.993
21.841	1.041	1.040	-0.001	0.991
23.480	1.121	1.100	-0.021	0.989
23.760	1.134	1.170	0.036	0.989
26.667	1.260	1.260	0.000	0.986
27.531	1.294	1.280	-0.014	0.985
30.339	1.397	1.380	-0.017	0.983
34.274	1.523	1.490	-0.033	0.980
48.661	1.865	1.880	0.015	0.972
59.300	2.043	2.080	0.037	0.969
66.619	2.142	2.120	-0.022	0.966
101.006	2.462	2.460	-0.002	0.959

Comments

Date of test: 9/18/2006
Waveform Type Sine

Test ID 5383-FCG-4Cpt05 Page 1

Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
	32.92	1.4821	579814					
1583	32.96	1.4835	579886	0.0032	165	1.936E-5	10.988	9.889
1587	33.02	1.4853	579979	0.0037	198	1.889E-5	11.025	9.922
1591	33.08	1.4872	580084	0.0019	96	1.980E-5	11.070	9.963
1596	33.16	1.4895	580197	0.0020	100	1.986E-5	11.114	10.003
1601	33.22	1.4915	580297	0.0020	100	2.006E-5	11.161	10.045
1605	33.28	1.4935	580388	0.0020	98	2.028E-5	11.205	10.085
1609	33.35	1.4954	580484	0.0019	95	2.040E-5	11.250	10.125
1614	33.41	1.4973	580580	0.0019	94	2.053E-5	11.293	10.164
1618	33.47	1.4992	580671	0.0019	94	2.059E-5	11.337	10.204
1622	33.53	1.5011	580767	0.0020	95	2.090E-5	11.381	10.243
1626	33.60	1.5031	580858	0.0020	94	2.110E-5	11.427	10.285
1631	33.66	1.5051	580954	0.0020	93	2.134E-5	11.474	10.327
1636	33.73	1.5072	581053	0.0020	92	2.145E-5	11.520	10.368
1640	33.80	1.5092	581141	0.0019	90	2.137E-5	11.568	10.411
1644	33.86	1.5111	581229	0.0019	90	2.142E-5	11.613	10.451
1649	33.92	1.5130	581320	0.0019	88	2.168E-5	11.656	10.490
1653	33.98	1.5147	581400	0.0037	171	2.155E-5	11.702	10.532
1657	34.05	1.5167	581491	0.0041	183	2.219E-5	11.747	10.572
	34.12	1.5188	581583					

Automated Fatigue Crack
Growth Rate Analysis

Test ID	5383-FCG-5	Geometry	C(T)
Contract	SSC 10624-01	Orientation	T-L
Material	5383-H116	Yield (ksi)	35.4
Temperature (F)	75	Modulus (Msi)	10.5
Environment	RH = 40%		

Specimen Dimensions (in)

Thickness	0.485	Height	2.400
Net Thickness	0.485	Notch Depth	1.000
Width	4.000	Gage Length	0.500

Precrack Parameters

Pmax (lbs)	940.0	Stress Ratio	0.10
Final a (in)	1.070	Kmax (ksi sqr[in])	5.00

Test Parameters

EvBP	Freq	Pmax	R	Ai	Kmaxi	C	DKi
22.287	24.00	0	0.10	1.070	5.00	-4.00	0.00
27.215	24.00	0	0.10	1.295	3.80	4.00	0.00

K Coeff	C Coeff	da/dN Fit Parameters (DKapp)	
.886	1.00098	Upper da/dN limit	3.937E-8
4.64	-4.66951	Lower da/dN limit	3.937E-9
-13.32	18.4601	da/dN intercept (C)	2.334E-20
14.72	-236.825	da/dN slope (m)	26.384
-5.6	1214.88	da/dN for delta K	3.937E-9
.	-2143.57	delta K	2.664

Visual Observations

EvB/P	Crack(EvB/P)	Crack(visual)	Error	CAF
20.522	0.994	1.000	0.006	1.014
22.228	1.092	1.080	-0.012	1.019
25.029	1.235	1.245	0.010	1.027
25.901	1.275	1.270	-0.005	1.029
27.145	1.296	1.310	0.014	1.001
29.657	1.385	1.380	-0.005	0.994
33.513	1.505	1.490	-0.015	0.985
54.805	1.955	1.960	0.005	0.951

Comments

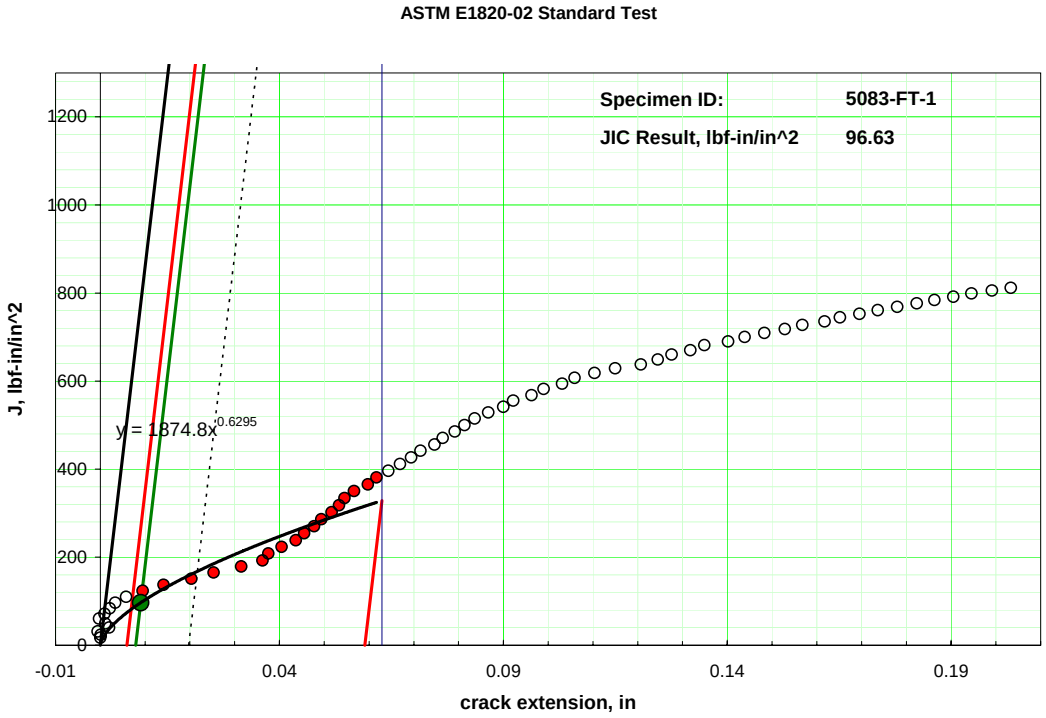
Date of test: 9/21/2006
Waveform Type Sine

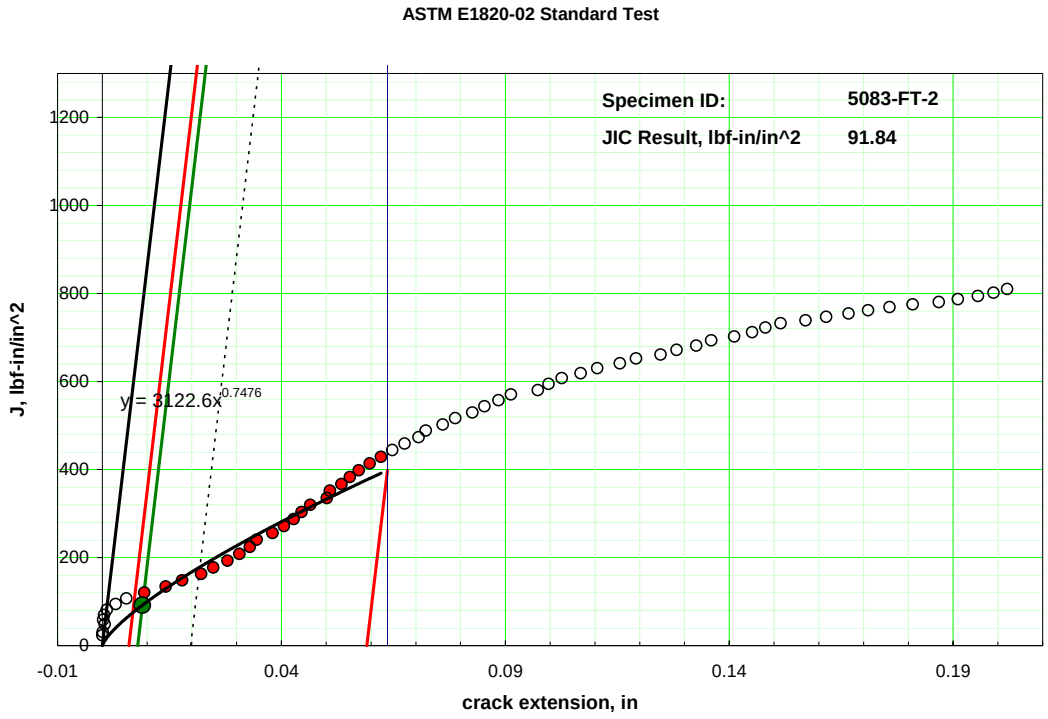
Test ID 5383-FCG-5 Page 1

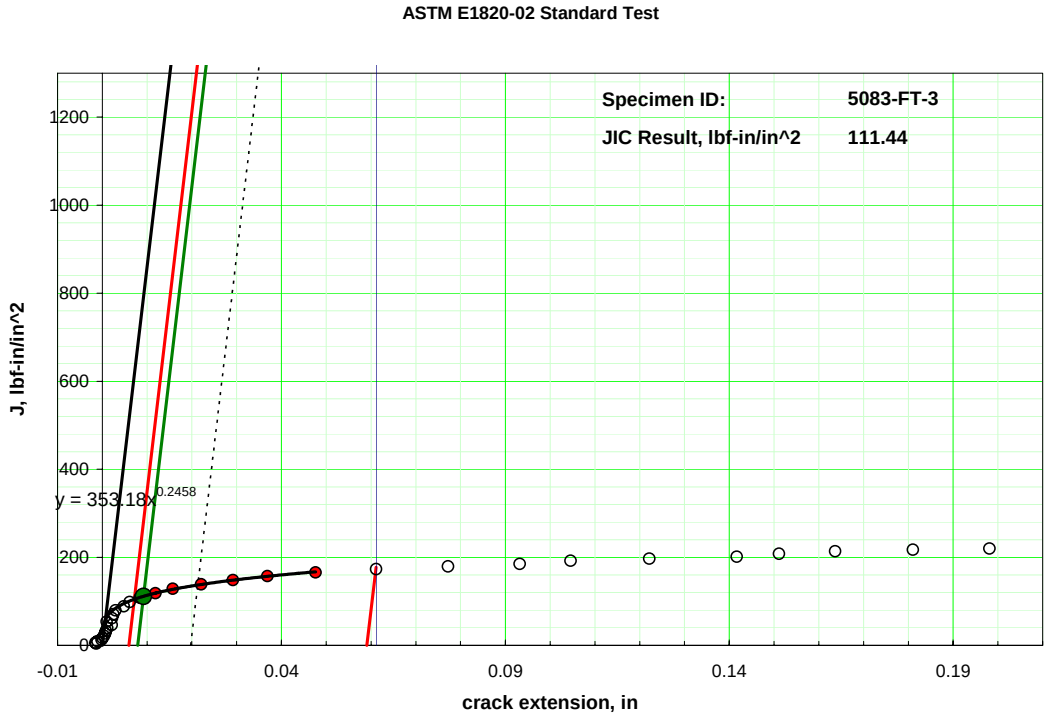
Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
	22.29	1.0954	7627					
907	22.38	1.1003	20207	0.0098	25134	3.918E-7	4.923	4.431
888	22.47	1.1053	32761	0.0104	27658	3.776E-7	4.827	4.344
866	22.57	1.1108	47865	0.0052	17462	3.359E-7	4.732	4.259
844	22.68	1.1164	70317	0.0053	19373	2.900E-7	4.639	4.175
826	22.77	1.1217	93159	0.0053	22485	2.547E-7	4.550	4.095
809	22.86	1.1264	112397	0.0054	24332	2.281E-7	4.459	4.013
789	22.97	1.1321	136443	0.0052	25439	2.167E-7	4.378	3.940
771	23.07	1.1374	167668	0.0053	27491	2.035E-7	4.288	3.859
753	23.18	1.1429	193854	0.0054	28528	1.872E-7	4.202	3.782
735	23.27	1.1479	222949	0.0051	29854	1.747E-7	4.123	3.711
719	23.38	1.1533	258105	0.0052	32813	1.711E-7	4.037	3.634
701	23.49	1.1590	283564	0.0053	34409	1.584E-7	3.966	3.570
688	23.56	1.1625	315568	0.0054	37136	1.520E-7	3.879	3.491
670	23.68	1.1688	364545	0.0053	40622	1.433E-7	3.816	3.434
657	23.79	1.1745	400307	0.0053	42944	1.265E-7	3.723	3.351
637	23.91	1.1803	445767	0.0056	43419	1.239E-7	3.665	3.299
626	24.00	1.1849	501834	0.0052	43590	1.183E-7	3.575	3.218
609	24.12	1.1909	541230	0.0052	51961	1.100E-7	3.518	3.167
597	24.22	1.1958	576081	0.0048	61192	1.086E-7	3.448	3.103
585	24.31	1.1999	626084	0.0047	68516	1.062E-7	3.382	3.043
570	24.42	1.2054	712071	0.0043	78963	6.965E-8	3.331	2.998
562	24.49	1.2090	812917	0.0038	89797	4.611E-8	3.269	2.942
551	24.58	1.2133	912927	0.0034	98106	3.498E-8	3.229	2.907
544	24.65	1.2164	1015005	0.0028	100417	2.787E-8	3.192	2.872
539	24.69	1.2184	1114861	0.0022	100253	2.165E-8	3.160	2.844
534	24.73	1.2206	1214718	0.0017	100227	1.596E-8	3.139	2.825
530	24.77	1.2221	1314575	0.0016	99857	1.421E-8	3.119	2.807
528	24.76	1.2220	1414432	0.0012	99857	1.218E-8	3.108	2.797
527	24.79	1.2233	1514289	0.0008	99857	9.415E-9	3.086	2.778
521	24.85	1.2259	1614145	0.0011	99857	1.040E-8	3.076	2.768
518	24.84	1.2258	1714002	0.0013	99857	1.221E-8	3.061	2.755
518	24.84	1.2256	1813859	0.0011	99857	1.127E-8	3.048	2.743
516	24.90	1.2286	1913716	0.0008	99857	9.714E-9	3.039	2.735
512	24.93	1.2300	2013572	0.0009	99857	9.823E-9	3.033	2.729
512	24.94	1.2302	2113429	0.0010	99857	8.605E-9	3.022	2.719
511	24.95	1.2306	2213285	0.0009	199713	4.674E-9	3.014	2.712
508	24.96	1.2311	2313142	0.0011	199714	5.453E-9	3.006	2.706
	24.97	1.2317	2412999					
	28.37	1.3404	388127					
736	28.51	1.3453	410668	0.0098	40963	2.402E-7	4.683	4.215
749	28.65	1.3503	429090	0.0092	32962	2.782E-7	4.778	4.300
761	28.77	1.3545	443630	0.0090	27722	3.252E-7	4.876	4.388
774	28.91	1.3593	456812	0.0046	11897	4.385E-7	4.968	4.471

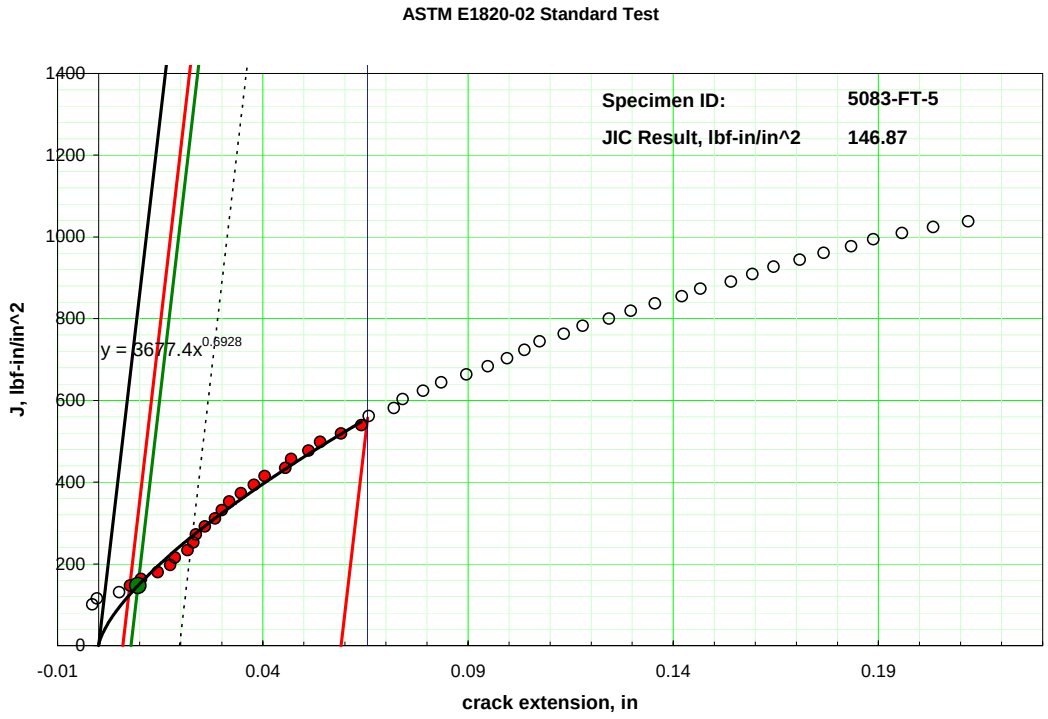
Pmax (lb)	EvB/P	a (in)	N	da (in)	dN	da/dN (in/cyc)	Kmax (ksi[in]^.5)	deltaK
787	29.04	1.3638	466583	0.0045	9780	5.280E-7	5.069	4.562
801	29.18	1.3685	474898	0.0046	8203	6.367E-7	5.168	4.651
814	29.31	1.3730	482048	0.0046	6811	7.405E-7	5.271	4.744
828	29.45	1.3775	487768	0.0046	5835	8.459E-7	5.380	4.842
843	29.59	1.3824	492849	0.0045	5019	9.596E-7	5.485	4.936
857	29.72	1.3869	497680	0.0046	4369	1.092E-6	5.595	5.036
870	29.86	1.3914	501595	0.0046	3920	1.221E-6	5.704	5.134
885	29.99	1.3958	505010	0.0046	3507	1.360E-6	5.817	5.235
900	30.14	1.4005	508263	0.0045	3067	1.527E-6	5.933	5.339
916	30.28	1.4052	511289	0.0046	2779	1.717E-6	6.051	5.446
931	30.42	1.4098	513891	0.0047	2505	1.932E-6	6.171	5.554
946	30.55	1.4142	516079	0.0046	2237	2.157E-6	6.298	5.668
963	30.71	1.4192	518267	0.0047	1997	2.436E-6	6.417	5.775
979	30.85	1.4237	520038	0.0047	1775	2.722E-6	6.552	5.897
996	31.00	1.4283	521685	0.0047	1600	3.020E-6	6.683	6.015
1014	31.15	1.4333	523268	0.0046	1422	3.352E-6	6.819	6.137
1031	31.30	1.4379	524539	0.0046	1305	3.649E-6	6.954	6.258
1047	31.43	1.4421	525677	0.0046	1181	3.967E-6	7.094	6.385
1065	31.59	1.4468	526797	0.0045	1060	4.320E-6	7.230	6.507
1083	31.74	1.4515	527865	0.0046	990	4.688E-6	7.374	6.637
1101	31.88	1.4560	528772	0.0047	936	5.050E-6	7.520	6.768
1119	32.03	1.4605	529626	0.0046	865	5.422E-6	7.670	6.903
1138	32.19	1.4653	530480	0.0046	789	5.840E-6	7.825	7.043
1159	32.35	1.4702	531292	0.0046	743	6.301E-6	7.982	7.184
1178	32.50	1.4747	531987	0.0047	702	6.722E-6	8.140	7.326
1197	32.64	1.4790	532600	0.0046	651	7.166E-6	8.304	7.474
1218	32.80	1.4838	533231	0.0046	602	7.665E-6	8.464	7.618
1238	32.96	1.4884	533835	0.0046	568	8.176E-6	8.637	7.773
1259	33.12	1.4931	534384	0.0094	1070	8.762E-6	8.809	7.928
1280	33.28	1.4978	534905	0.0093	1009	9.253E-6	8.986	8.088
	33.44	1.5025	535393					

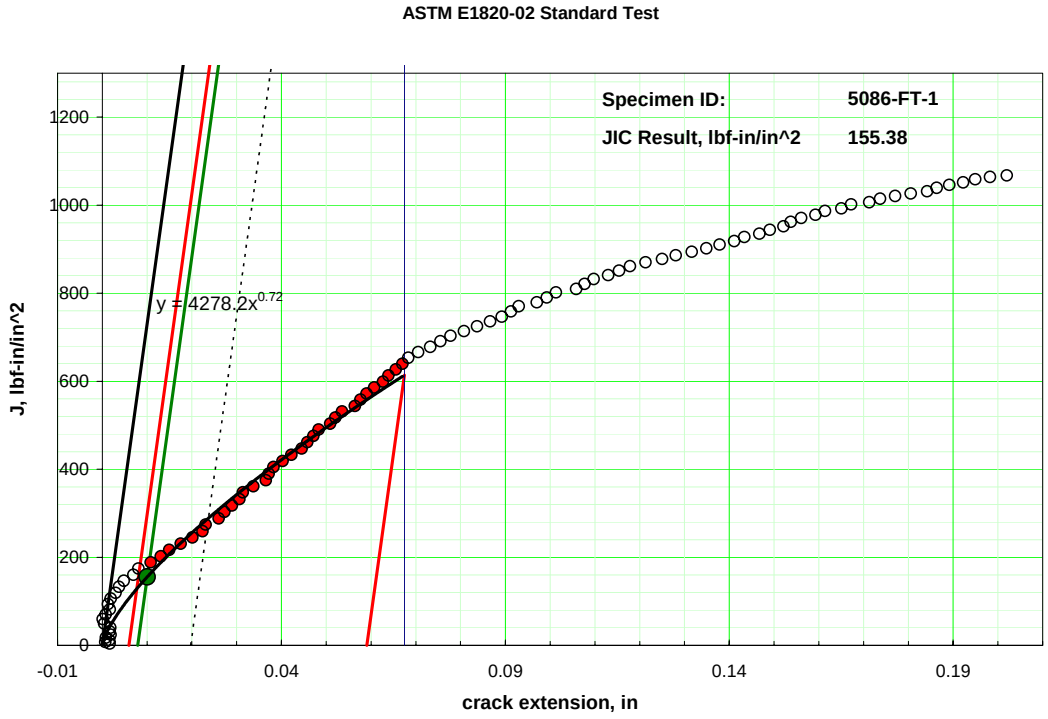
Annex F – Individual J *vs.* Δa Curves

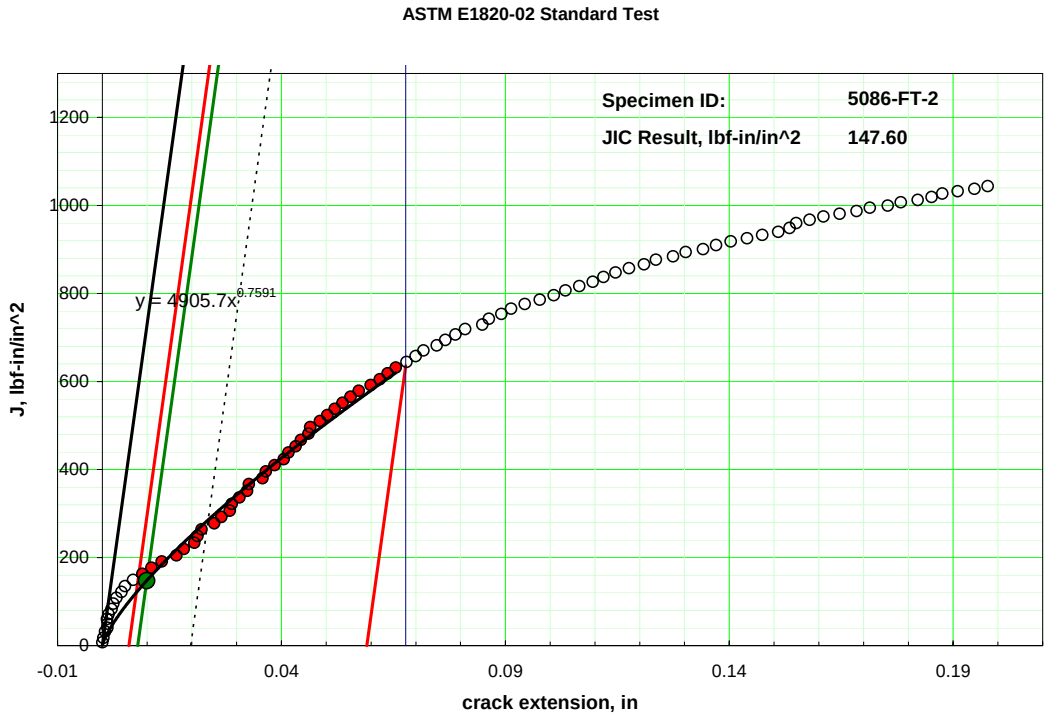


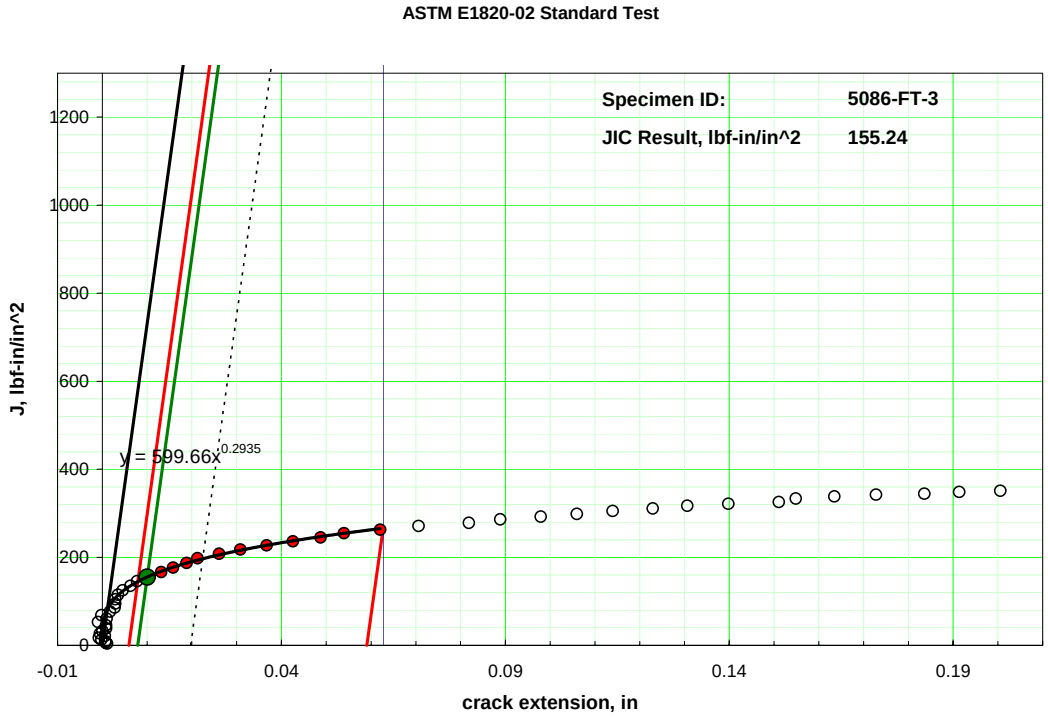

ASTM E1820-02 Standard Test
Specimen ID: 5083-FT-2
JIC Result, lbf-in/in^2 91.84
y = 3122.6x^0.7476
J, lbf-in/in^2
crack extension, in
0
200
400
600
800
1000
1200
-0.01
0.04
0.09
0.14
0.19

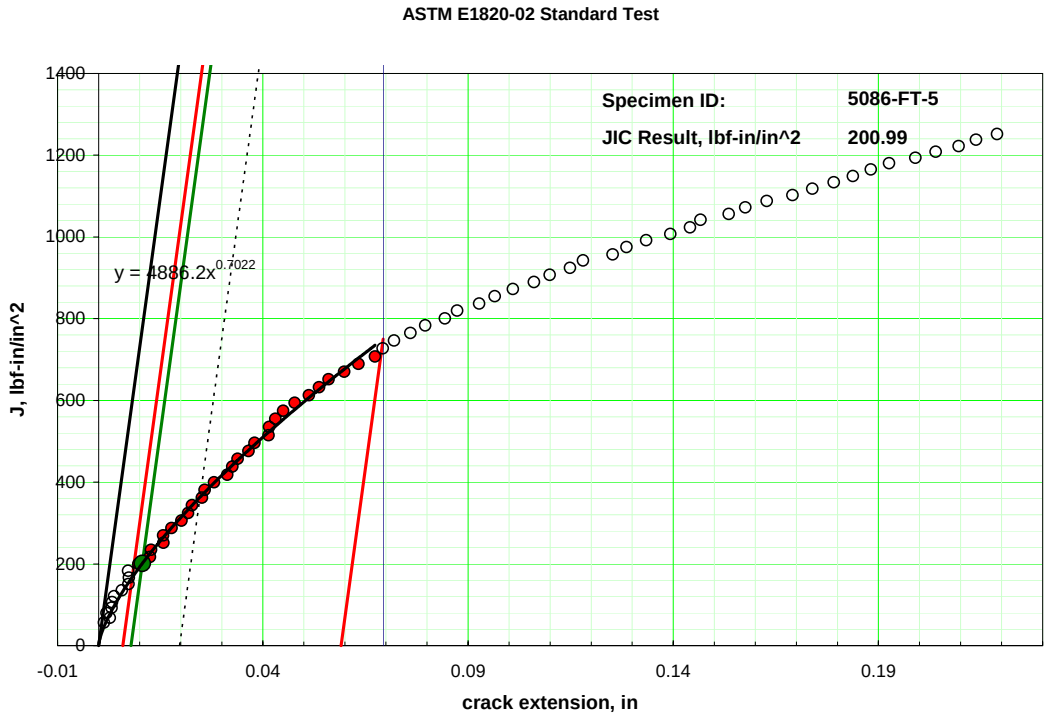

ASTM E1820-02 Standard Test
Specimen ID: 5083-FT-3
JIC Result, lbf-in/in^2 111.44
y = 353.18x^0.2458
J, lbf-in/in^2
crack extension, in
0
200
400
600
800
1000
1200
-0.01
0.04
0.09
0.14
0.19

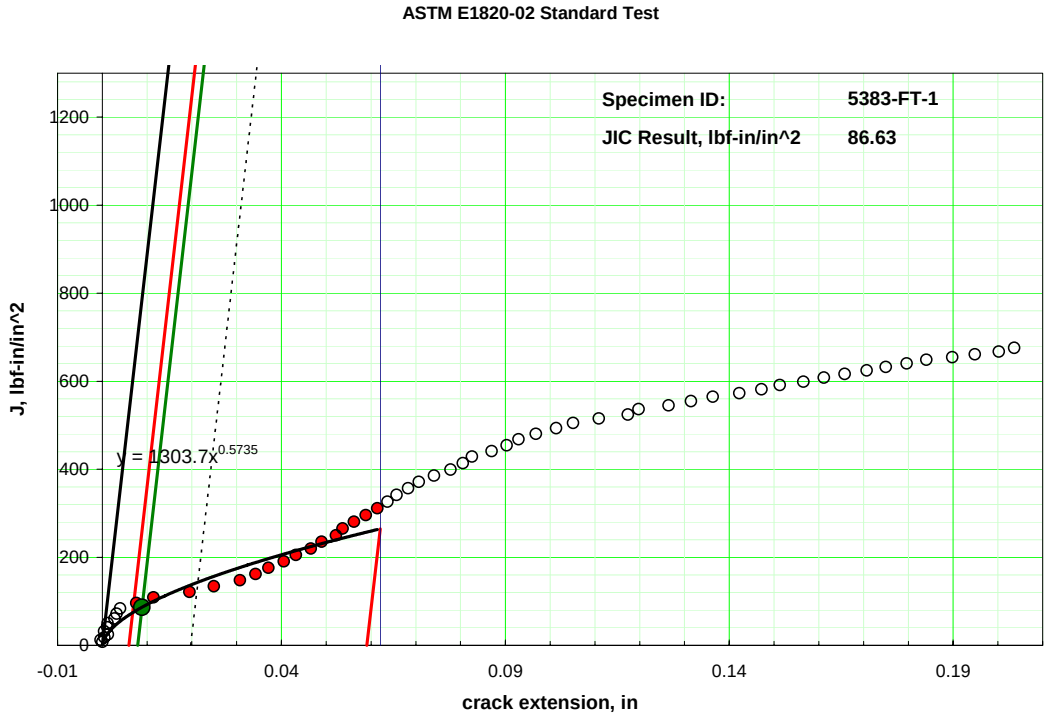

ASTM E1820-02 Standard Test
Specimen ID: 5083-FT-5
JIC Result, lbf-in/in^2 146.87
y = 3677.4x^0.6928
J, lbf-in/in^2
crack extension, in
1400
1200
1000
800
600
400
200
0
-0.01
0.04
0.09
0.14
0.19

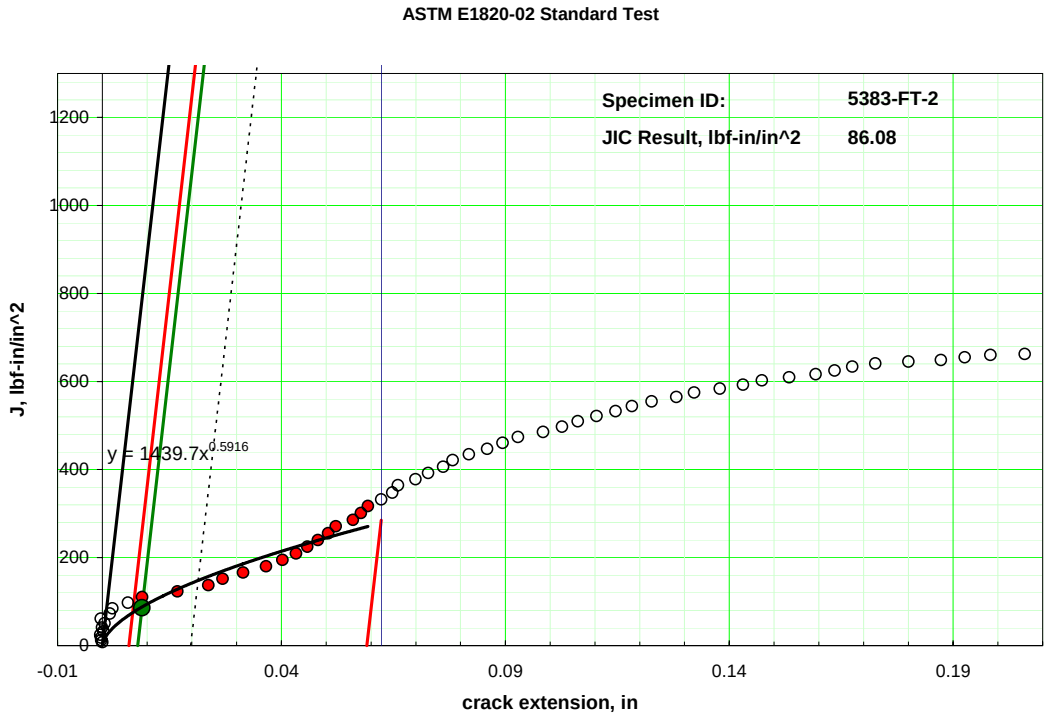

ASTM E1820-02 Standard Test
Specimen ID: 5086-FT-1
JIC Result, lbf-in/in^2 155.38
y = 4278.2x^0.72
J, lbf-in/in^2
crack extension, in
1200
1000
800
600
400
200
0
-0.01
0.04
0.09
0.14
0.19

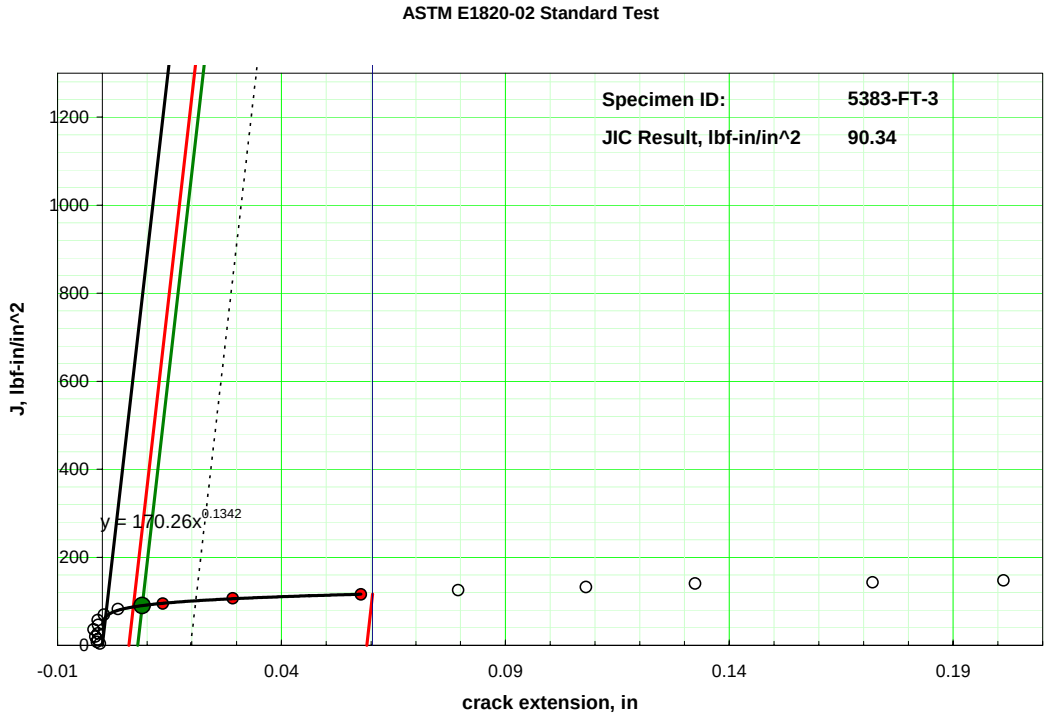

ASTM E1820-02 Standard Test
Specimen ID: 5086-FT-2
JIC Result, lbf-in/in^2 147.60
y = 4905.7x^0.7591
J, lbf-in/in^2
crack extension, in
0
200
400
600
800
1000
1200
-0.01
0.04
0.09
0.14
0.19

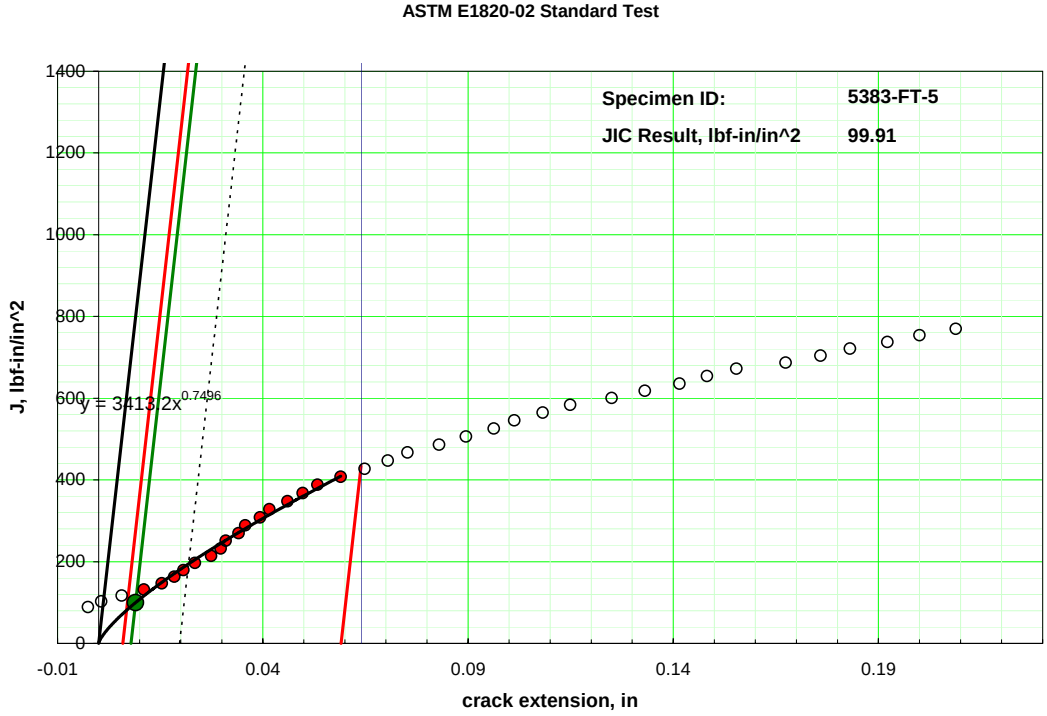

ASTM E1820-02 Standard Test
Specimen ID: 5086-FT-3
JIC Result, lbf-in/in^2 155.24
y = 599.66x^0.2935
J, lbf-in/in^2
crack extension, in
0
200
400
600
800
1000
1200
-0.01
0.04
0.09
0.14
0.19


ASTM E1820-02 Standard Test
Specimen ID: 5086-FT-5
JIC Result, lbf-in/in^2 200.99
y = 4886.2x^0.7022
J, lbf-in/in^2
crack extension, in
1400
1200
1000
800
600
400
200
0
-0.01
0.04
0.09
0.14
0.19

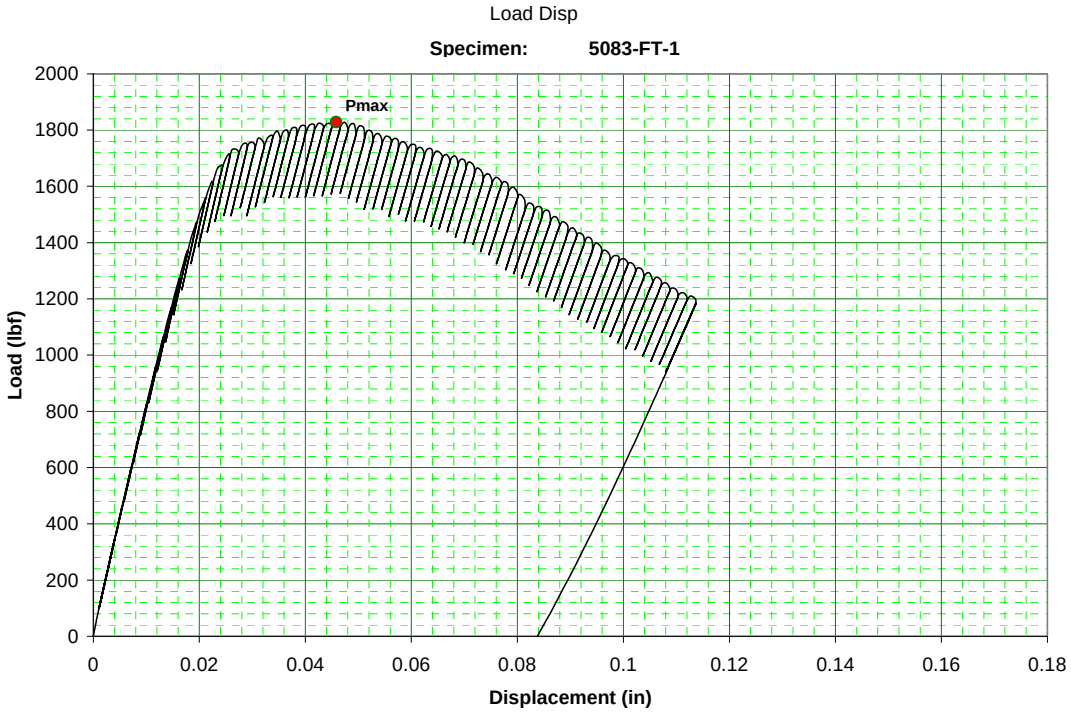

ASTM E1820-02 Standard Test
Specimen ID: 5383-FT-1
JIC Result, lbf-in/in^2 86.63
y = 1303.7x^0.5735
J, lbf-in/in^2
crack extension, in
1200
1000
800
600
400
200
0
-0.01
0.04
0.09
0.14
0.19

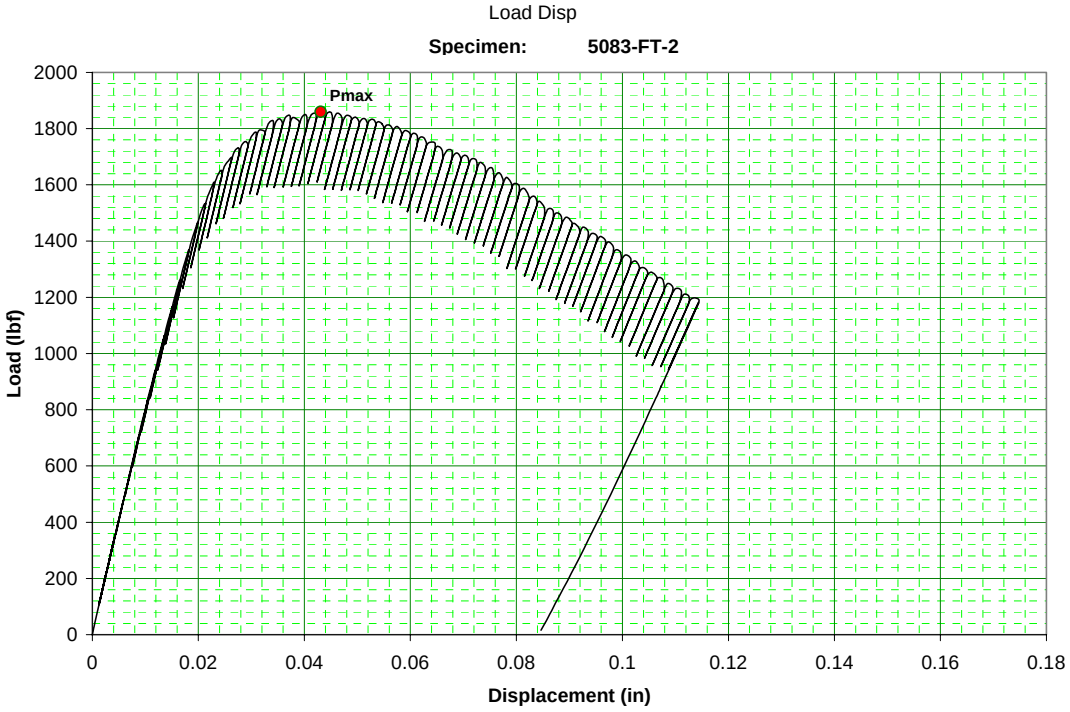

ASTM E1820-02 Standard Test
Specimen ID: 5383-FT-2
JIC Result, lbf-in/in^2 86.08
y = 1439.7x^0.5916
J, lbf-in/in^2
crack extension, in
0
200
400
600
800
1000
1200
-0.01
0.04
0.09
0.14
0.19

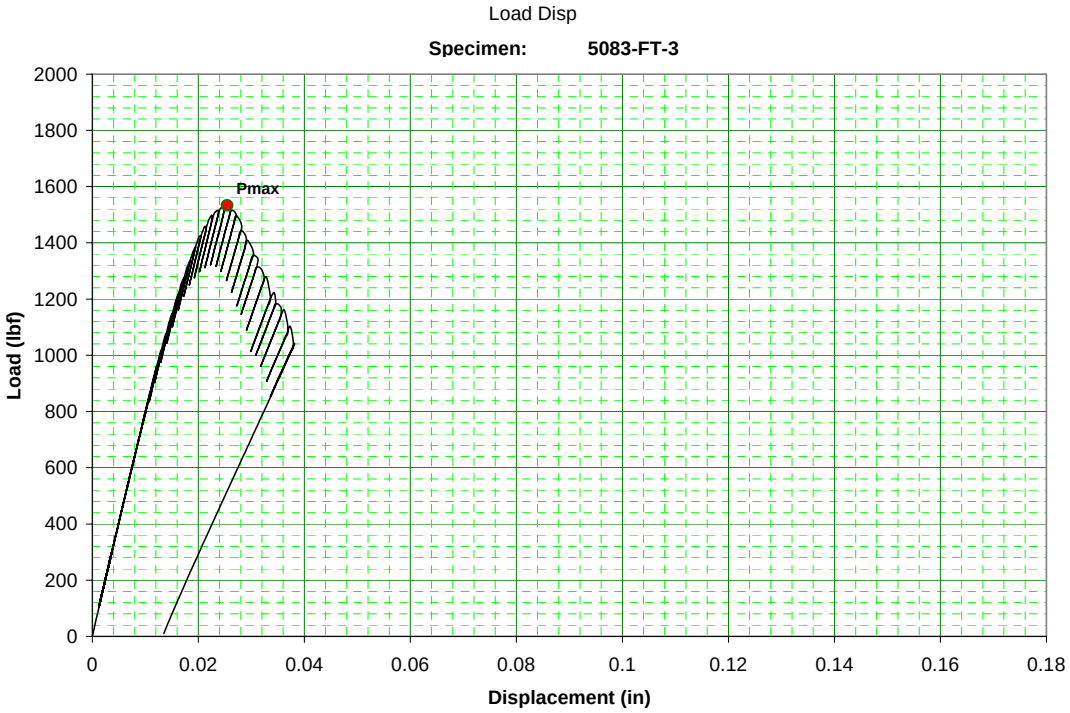

ASTM E1820-02 Standard Test
Specimen ID: 5383-FT-3
JIC Result, lbf-in/in^2 90.34
y = 170.26x^0.1342
J, lbf-in/in^2
crack extension, in
0
200
400
600
800
1000
1200
-0.01
0.04
0.09
0.14
0.19

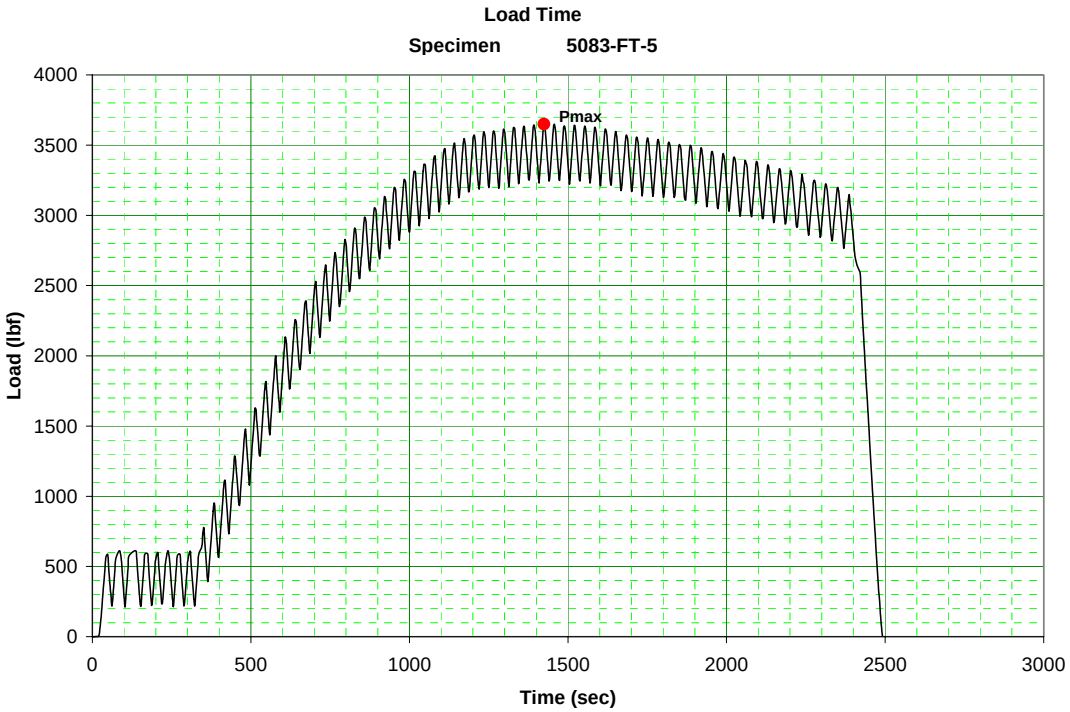

ASTM E1820-02 Standard Test
Specimen ID: 5383-FT-5
JIC Result, lbf-in/in^2 99.91
y = 3413.2x^0.7496
J, lbf-in/in^2
crack extension, in
1400
1200
1000
800
600
400
200
0
-0.01
0.04
0.09
0.14
0.19

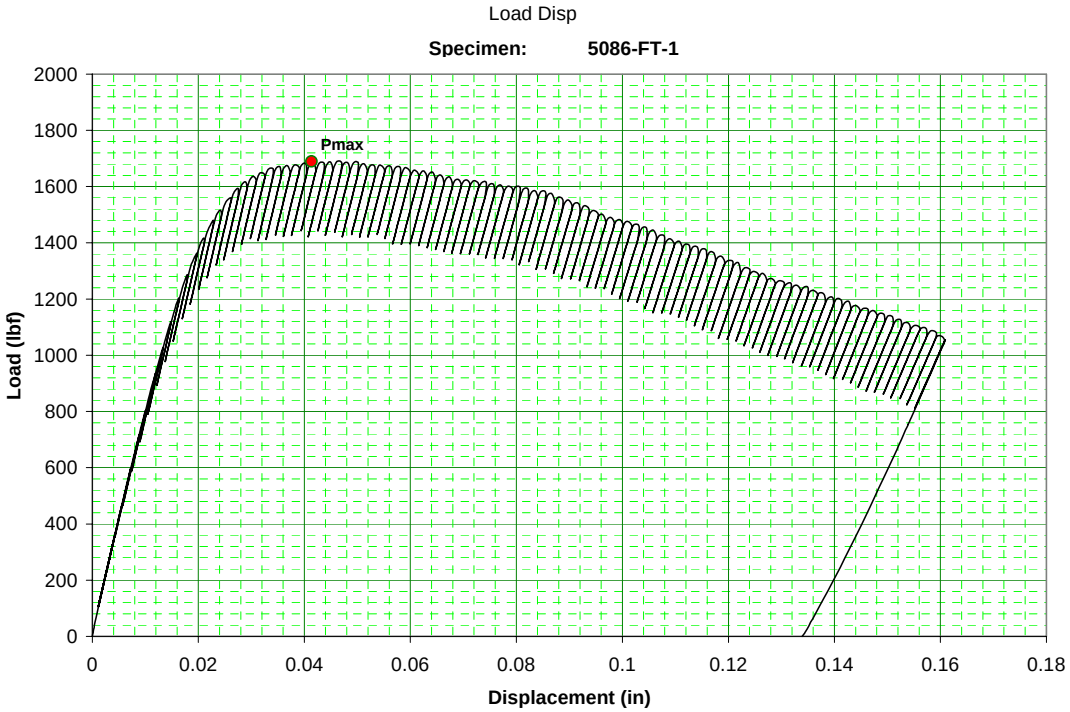
Annex G – Load *vs.* Load-Line Displacement Plots

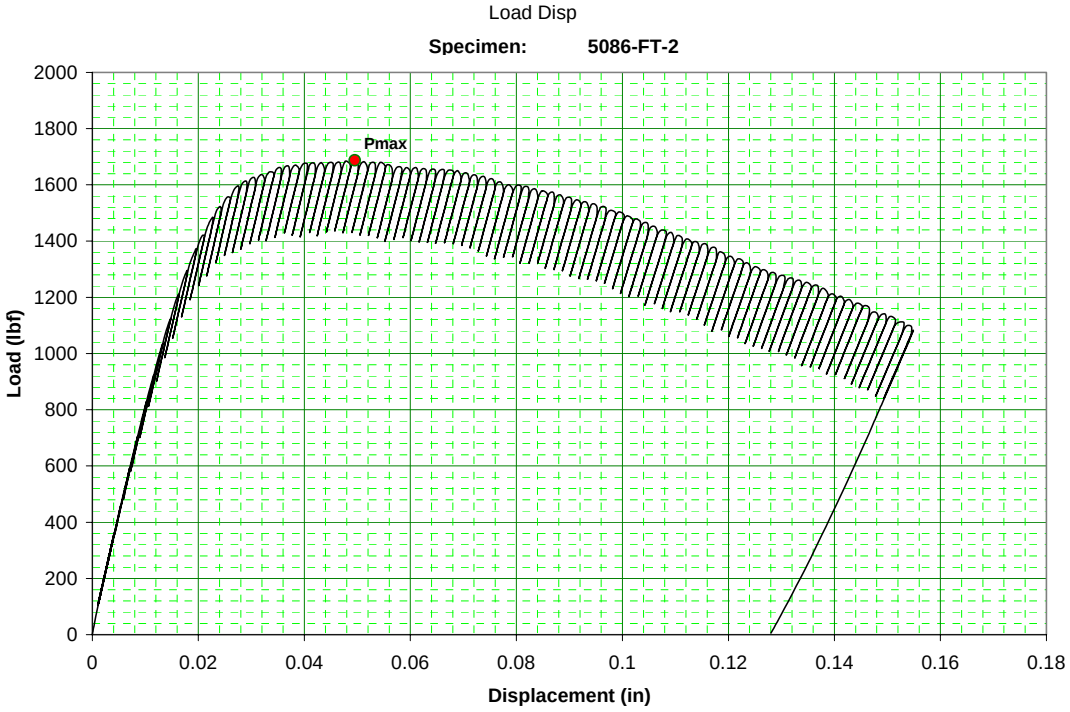


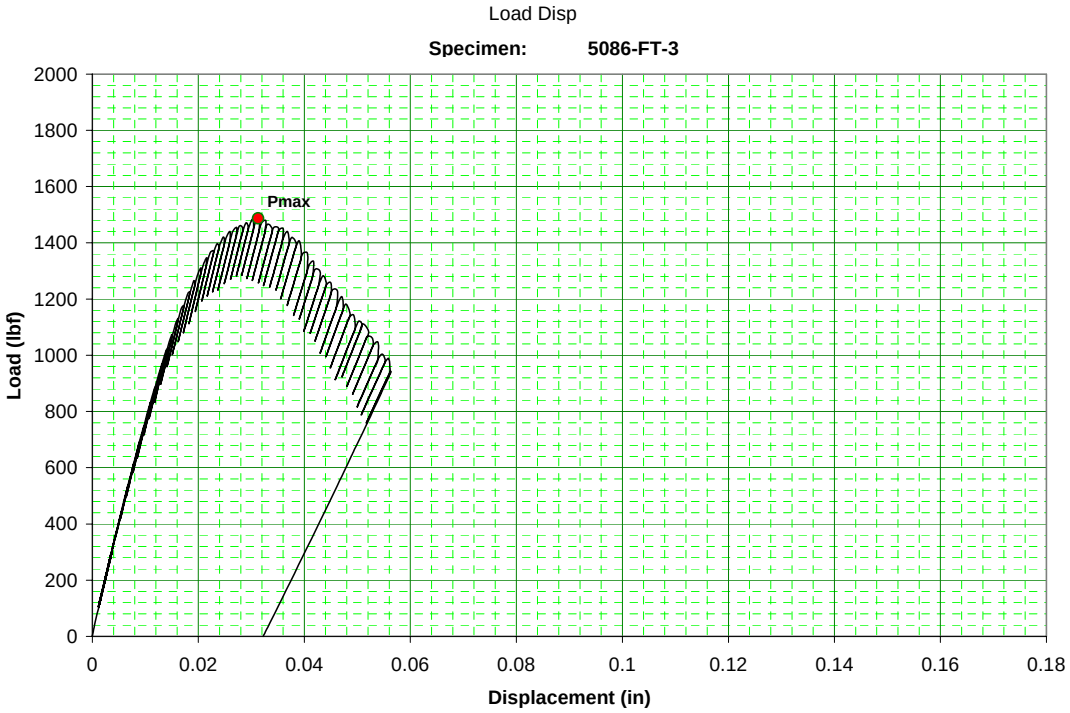

Load Disp
Specimen: 5083-FT-2
Pmax
Load (lbf)
Displacement (in)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0.18


Load Disp
Specimen: 5083-FT-3
Pmax
Load (lbf)
Displacement (in)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0.18


Load Time
Specimen 5083-FT-5
Pmax
Load (lbf)
Time (sec)
0
500
1000
1500
2000
2500
3000
3500
4000


Load Disp
Specimen: 5086-FT-1
Pmax
Load (lbf)
Displacement (in)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0.18


Load Disp
Specimen: 5086-FT-2
Pmax
Load (lbf)
Displacement (in)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0.18


Load Disp
Specimen: 5086-FT-3
Pmax
Load (lbf)
Displacement (in)
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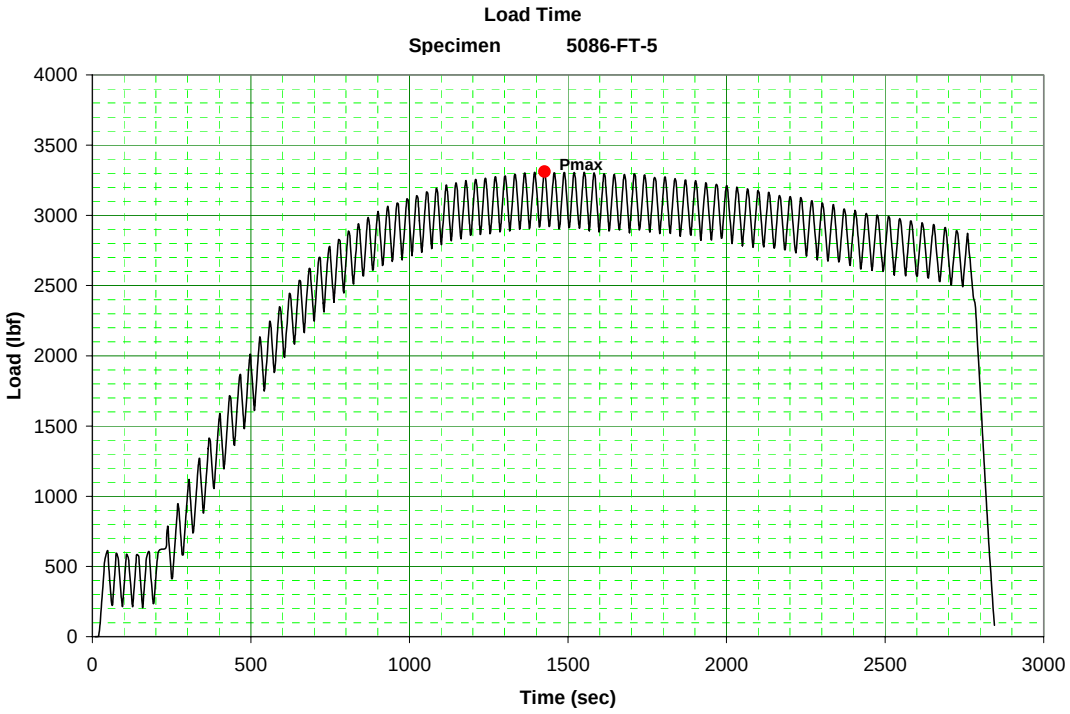
400
600
800
1000
1200
1400
1600
1800
2000
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0.18


Load Time
Specimen 5086-FT-5
Pmax
Load (lbf)
Time (sec)
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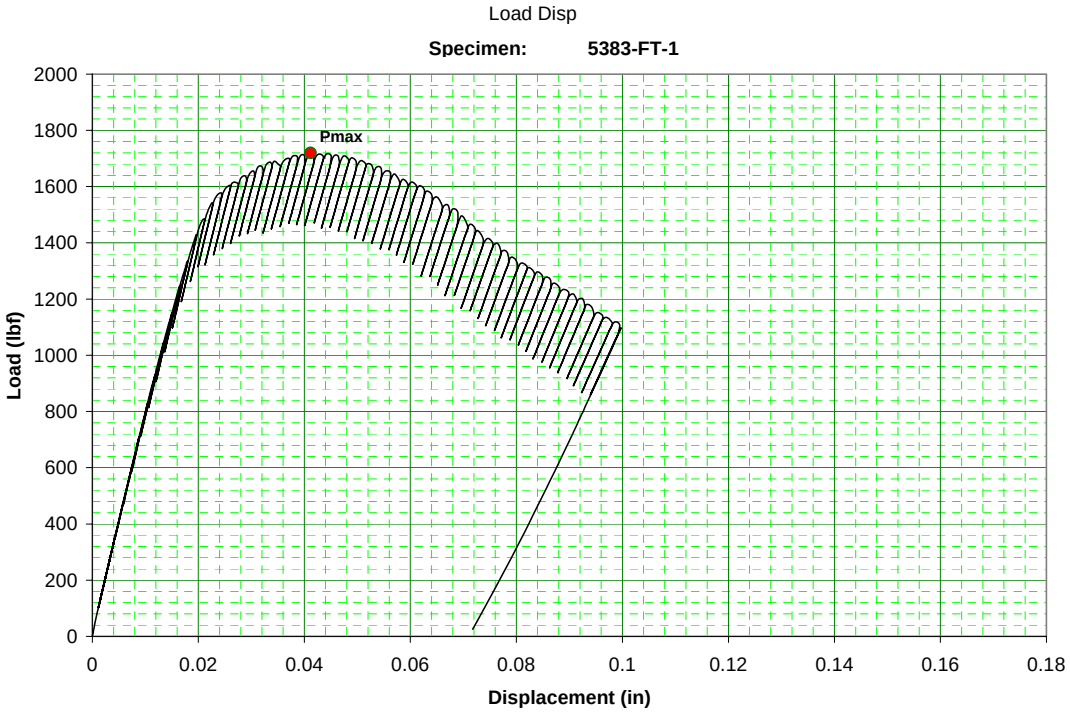
500
1000
1500
2000
2500
3000
3500
4000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Specimen: 5383-FT-1
Pmax
Load (lbf)
Displacement (in)
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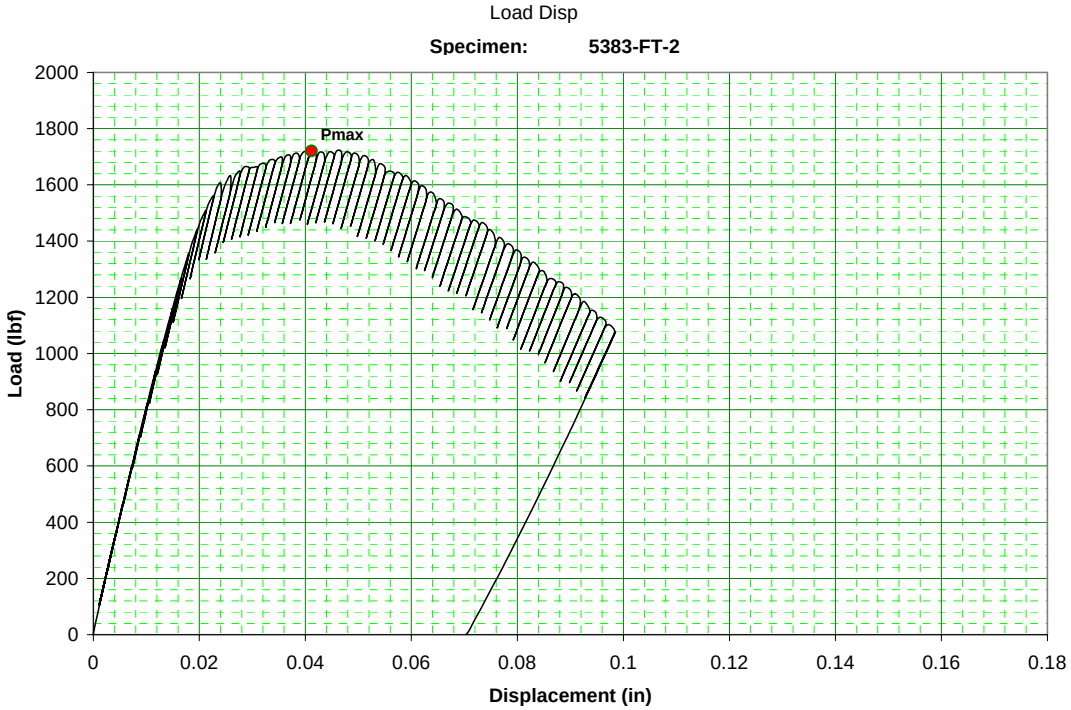
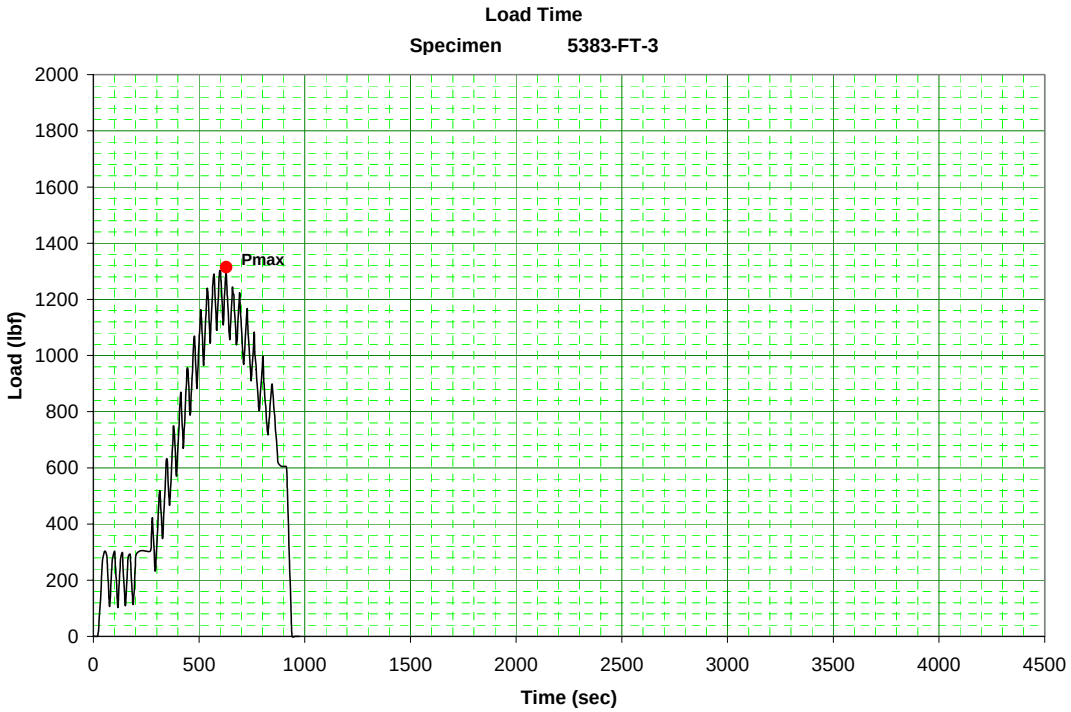
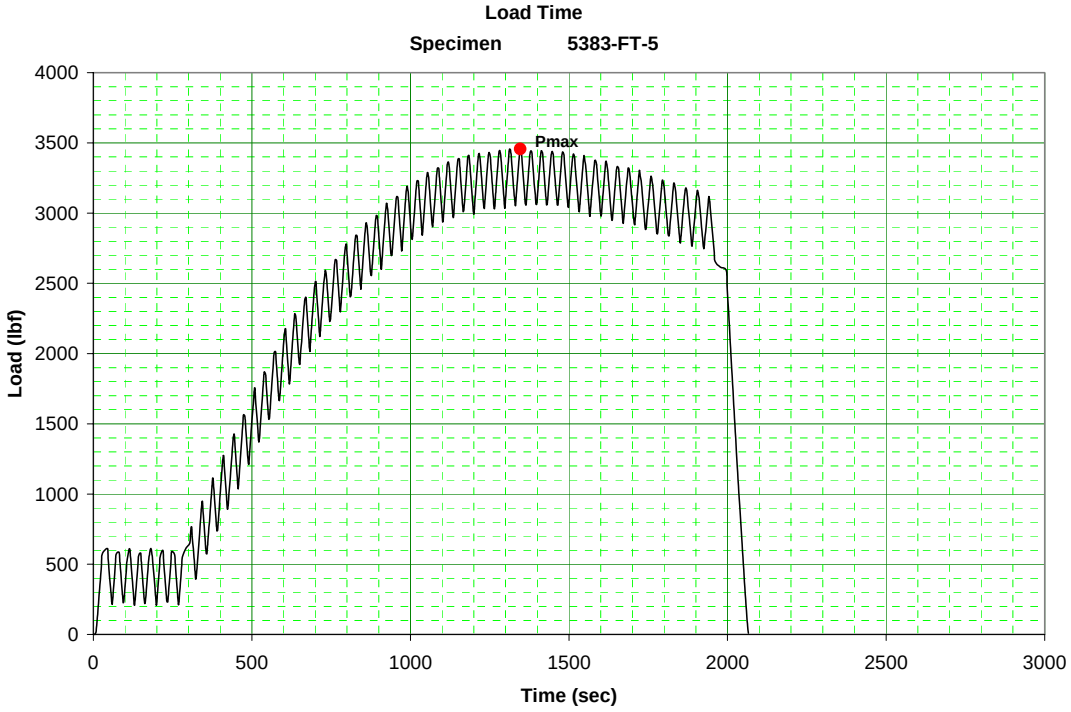
200
400
600
800
1000
1200
1400
1600
1800
2000
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0.18


Load Disp
Specimen: 5383-FT-2
Pmax
Load (lbf)
Displacement (in)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0.18


Load Time
Specimen 5383-FT-3
Pmax
Load (lbf)
Time (sec)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
0
500
1000
1500
2000
2500
3000
3500
4000
4500


Load Time
Specimen 5383-FT-5
Pmax
Load (lbf)
Time (sec)
0
500
1000
1500
2000
2500
3000
3500
4000

Annex H – Tabular Results – ASTM E1820 Analysis

Elastic-Plastic Fracture Toughness Analysis

Specimen ID	5083-FT-1	Geometry	C(T)
Contract	SSC 10624-01	Orientation	T-L
Material	5083-H321	Yield (ksi)	34.3
Temperature(F)	75.0	Tensile (ksi)	51.8
Environment	LAB AIR	Modulus (Msi)	10.5

Specimen Dimensions

Thickness (in)	0.500	Notch Depth (in)	1.100
Net Thickness (in)	0.500	Gage Length (in)	0.200
Width (in)	2.000	Alpha Ratio	1
Pin Spacing (in)	1.100		

Precrack Parameters

Pmax (lbf)	310.0	Stress Ratio	0.1
Final a (in)	1.200	Kmax (ksi sqrt (in))	6.0
Pf (lbf)	1056		

Initial measured crack lengths (in)

1.182	1.195	1.199	1.200	1.205	1.208	1.209	1.206	1.196

Final measured crack lengths (in)

1.318	1.348	1.440	1.583	1.682	1.573	1.427	1.349	1.329
x	x		x	x	x		x	x

Ave. initial crack length (in)	1.201	aoq (in)	n/a
Ave. final crack length (in)	1.466	Compliance Adj. Factor	1.014
Delta a measured (in)	0.264	Effective Modulus (Msi)	10.6
Delta a predicted (in)	0.203		

Results

J_Q (E1820)	96.6 lbf-in/in^2
K_{JIC}(E'*JQ)^1/2	33.4 ksi sqrt(in)

Qualification of Data

7.4.2: precrack length	valid
9.1.4.1; precrack	valid
9.1.4.2; final crack	invalid
9.1.5.1; Δa meas	valid
9.1.5.2; Δa pred	invalid
A9.6.4; # of pnts in reg.A	valid
A9.6.4; # of pnts in reg.B	valid
A9.8.1; C_2<1	valid
A9.8.2.1; a_{0q}-a_0	#VALUE!
A9.8.2.2; # of pnts for J_Q	valid
A9.8.2.2; # of pnts < J_Q	valid
A9.3.3.1; correlation	valid

Qualification of J_Q as J_{IC}

A9.9.1; thickness	valid
A9.9.2; ligament	valid
A9.9.3; slope	valid

Index	Time	Force	Disp1	Disp2	Crack	Δa	CTOD	K561	K1820	KJ1820	J1820	Je	Jpl
	Sec	lbf	inch	inch	inch	inch	inch	ksi sqr(in)	ksi sqr(in)	ksi sqr(in)	lbf/in	lbf/in	lbf/in
8	391.1	727.8	0.00877	0.11444	1.2018	0.0000	0.00027	14.59	14.10	14.10	17.23	17.24	-0.01
9	428.8	847.8	0.01032	0.13367	1.2018	0.0001	0.00038	17.21	16.43	16.60	23.87	23.40	0.47
10	465.8	965.4	0.01187	0.15198	1.2012	-0.0006	0.00052	19.84	18.68	19.09	31.57	30.26	1.31
11	502.6	1078.9	0.01341	0.17029	1.2037	0.0020	0.00066	22.66	20.99	21.49	40.01	38.17	1.84
12	539	1187.1	0.01496	0.18707	1.2028	0.0011	0.00084	25.29	23.05	23.94	49.68	46.05	3.63
13	575.1	1291.3	0.01652	0.20325	1.2015	-0.0003	0.00105	27.90	25.01	26.39	60.37	54.20	6.17
14	610.8	1390.5	0.01808	0.21820	1.2027	0.0009	0.00125	30.70	26.99	28.75	71.64	63.15	8.49
15	646.5	1480.1	0.01964	0.23193	1.2039	0.0021	0.00148	33.38	28.80	31.09	83.77	71.88	11.89
16	681.6	1559.9	0.02121	0.24536	1.2051	0.0033	0.00173	35.92	30.42	33.40	96.68	80.22	16.46
17	716.6	1631.3	0.02278	0.25726	1.2075	0.0057	0.00198	38.47	31.97	35.62	109.97	88.58	21.39
18	751.1	1673.0	0.02436	0.26306	1.2112	0.0095	0.00227	40.32	33.03	37.76	123.58	94.55	29.03
19	785.8	1723.0	0.02596	0.27039	1.2159	0.0141	0.00255	42.72	34.34	39.84	137.56	102.17	35.39
20	820.1	1729.1	0.02754	0.27283	1.2221	0.0203	0.00286	43.83	34.89	41.76	151.13	105.50	45.63
21	854.6	1745.0	0.02912	0.27344	1.2271	0.0253	0.00318	45.20	35.57	43.66	165.17	109.64	55.53
22	889.3	1754.2	0.03070	0.27496	1.2332	0.0315	0.00350	46.56	36.21	45.42	178.83	113.62	65.21
23	924	1747.4	0.03224	0.27466	1.2380	0.0362	0.00384	47.08	36.42	47.15	192.70	114.98	77.71
24	959.8	1778.4	0.03384	0.28015	1.2393	0.0375	0.00417	48.63	37.17	49.03	208.36	119.74	88.62
25	995	1779.0	0.03542	0.27985	1.2422	0.0405	0.00452	49.20	37.41	50.76	223.34	121.30	102.05
26	1030.6	1796.4	0.03703	0.28137	1.2454	0.0436	0.00487	50.58	38.03	52.47	238.64	125.33	113.31
27	1066.1	1802.4	0.03862	0.28351	1.2473	0.0455	0.00523	51.23	38.31	54.18	254.36	127.17	127.19
28	1101.6	1804.5	0.04022	0.28381	1.2495	0.0478	0.00560	51.78	38.53	55.83	270.18	128.66	141.52
29	1137.5	1811.5	0.04182	0.28656	1.2511	0.0494	0.00597	52.45	38.81	57.47	286.21	130.55	155.66
30	1173.2	1812.4	0.04343	0.28442	1.2534	0.0517	0.00634	52.98	39.02	59.03	302.04	131.94	170.10
31	1209.1	1817.9	0.04502	0.28534	1.2551	0.0533	0.00671	53.61	39.27	60.57	317.98	133.68	184.30
32	1245	1817.6	0.04662	0.28534	1.2563	0.0545	0.00709	53.86	39.37	62.12	334.46	134.34	200.12
33	1280.9	1815.8	0.04821	0.28473	1.2584	0.0567	0.00747	54.24	39.51	63.56	350.10	135.28	214.82
34	1317	1808.5	0.04982	0.28412	1.2615	0.0597	0.00786	54.56	39.61	64.93	365.34	135.96	229.38
35	1352.9	1791.4	0.05143	0.28076	1.2634	0.0617	0.00826	54.11	39.40	66.32	381.24	134.52	246.72
36	1389.1	1783.4	0.05303	0.27954	1.2661	0.0643	0.00865	54.30	39.45	67.63	396.36	134.86	261.50
37	1425.5	1768.8	0.05465	0.28046	1.2687	0.0669	0.00906	54.13	39.34	68.92	411.65	134.15	277.50
38	1462.2	1763.5	0.05624	0.27832	1.2712	0.0694	0.00945	54.42	39.44	70.16	426.59	134.78	291.81
39	1499.1	1757.2	0.05783	0.27527	1.2733	0.0715	0.00984	54.57	39.47	71.39	441.71	135.04	306.67
40	1536.1	1743.8	0.05942	0.27435	1.2764	0.0746	0.01024	54.58	39.44	72.53	455.93	134.82	321.11
41	1573.4	1735.7	0.06101	0.27313	1.2782	0.0765	0.01064	54.58	39.42	73.72	471.06	134.66	336.40
42	1610.5	1726.4	0.06261	0.27069	1.2809	0.0792	0.01105	54.70	39.44	74.85	485.49	134.80	350.69
43	1648.1	1717.8	0.06418	0.26978	1.2831	0.0813	0.01144	54.75	39.43	75.95	499.95	134.76	365.19
44	1685.9	1706.4	0.06582	0.26794	1.2854	0.0836	0.01187	54.66	39.37	77.09	515.03	134.30	380.73
45	1723.9	1699.7	0.06740	0.26825	1.2884	0.0866	0.01226	55.01	39.48	78.09	528.53	135.06	393.48
46	1761.9	1693.6	0.06897	0.26642	1.2918	0.0900	0.01266	55.49	39.63	79.05	541.53	136.12	405.41
47	1800.1	1685.3	0.07054	0.26581	1.2940	0.0922	0.01306	55.58	39.64	80.07	555.66	136.16	419.50
48	1838.6	1665.2	0.07215	0.26215	1.2981	0.0963	0.01350	55.43	39.52	80.96	568.13	135.39	432.74
49	1877.2	1642.0	0.07380	0.25818	1.3008	0.0990	0.01395	54.74	39.21	81.96	582.22	133.26	448.97
50	1916.6	1629.8	0.07541	0.25665	1.3049	0.1031	0.01437	55.06	39.29	82.79	594.09	133.79	460.31
51	1955.9	1612.6	0.07701	0.25391	1.3077	0.1059	0.01480	54.73	39.12	83.71	607.28	132.64	474.64
52	1995.4	1599.3	0.07861	0.25085	1.3121	0.1103	0.01523	55.06	39.20	84.47	618.33	133.16	485.17
53	2035.1	1573.2	0.08020	0.24811	1.3167	0.1150	0.01568	54.64	38.97	85.19	628.99	131.63	497.36
54	2074.9	1538.4	0.08178	0.24170	1.3225	0.1207	0.01615	53.98	38.63	85.78	637.70	129.31	508.39
55	2115.9	1525.3	0.08337	0.23956	1.3263	0.1245	0.01659	54.13	38.64	86.52	648.75	129.40	519.35
56	2157.1	1512.4	0.08494	0.23834	1.3293	0.1276	0.01702	54.11	38.59	87.29	660.37	129.10	531.27
57	2198.2	1492.0	0.08650	0.23529	1.3335	0.1317	0.01747	53.89	38.45	87.94	670.25	128.15	542.10
58	2239.9	1473.1	0.08810	0.23254	1.3367	0.1349	0.01793	53.50	38.25	88.69	681.67	126.82	554.84
59	2281.9	1447.1	0.08971	0.22858	1.3420	0.1402	0.01840	53.20	38.06	89.23	690.02	125.57	564.45
60	2324.6	1434.0	0.09129	0.22553	1.3457	0.1439	0.01885	53.30	38.06	89.88	700.06	125.53	574.53
61	2367.4	1416.6	0.09291	0.22339	1.3501	0.1483	0.01932	53.30	38.00	90.47	709.40	125.16	584.24
62	2410.6	1395.3	0.09454	0.22125	1.3547	0.1529	0.01980	53.08	37.85	91.04	718.24	124.19	594.05
63	2454.4	1374.7	0.09615	0.21790	1.3585	0.1568	0.02028	52.72	37.66	91.63	727.69	122.90	604.80

Index	Time	Force	Disp1	Disp2	Crack	Δa	CTOD	K561	K1820	KJ1820	J1820	Je	Jpl
	Sec	lbf	inch	inch	inch	inch	inch	ksi sqr(in)	ksi sqr(in)	ksi sqr(in)	lbf/in	lbf/in	lbf/in
64	2498.6	1353.8	0.09775	0.21484	1.3635	0.1617	0.02077	52.60	37.55	92.11	735.33	122.17	613.15
65	2543.4	1342.6	0.09933	0.21210	1.3669	0.1652	0.02122	52.75	37.56	92.70	744.80	122.26	622.53
66	2588.6	1329.3	0.10091	0.21057	1.3713	0.1695	0.02168	52.99	37.60	93.19	752.65	122.53	630.12
67	2634.2	1310.0	0.10252	0.20843	1.3754	0.1736	0.02217	52.73	37.44	93.71	761.03	121.51	639.52
68	2679.9	1290.9	0.10410	0.20416	1.3797	0.1780	0.02266	52.54	37.31	94.17	768.63	120.65	647.98
69	2726.7	1273.5	0.10573	0.20111	1.3841	0.1823	0.02316	52.47	37.22	94.65	776.41	120.09	656.33
70	2773.9	1259.2	0.10732	0.19928	1.3881	0.1863	0.02364	52.52	37.19	95.12	784.15	119.86	664.29
71	2821.6	1239.0	0.10894	0.19714	1.3923	0.1905	0.02414	52.19	37.00	95.57	791.61	118.65	672.96
72	2869.7	1221.5	0.11055	0.19501	1.3963	0.1946	0.02465	51.99	36.87	96.02	799.14	117.79	681.34
73	2918.6	1205.8	0.11216	0.19165	1.4009	0.1991	0.02515	52.07	36.84	96.41	805.51	117.62	687.90
74	2967.7	1190.9	0.11374	0.18951	1.4051	0.2034	0.02564	52.12	36.80	96.79	811.95	117.37	694.58

Elastic-Plastic Fracture Toughness Analysis

Specimen ID	5083-FT-2	Geometry	C(T)
Contract	SSC 10624-01	Orientation	T-L
Material	5083-H321	Yield (ksi)	34.3
Temperature(F)	75.0	Tensile (ksi)	51.8
Environment	LAB AIR	Modulus (Msi)	10.5

Specimen Dimensions

Thickness (in)	0.500	Notch Depth (in)	1.100
Net Thickness (in)	0.500	Gage Length (in)	0.200
Width (in)	2.000	Alpha Ratio	1
Pin Spacing (in)	1.100		

Precrack Parameters

Pmax (lbf)	310.0	Stress Ratio	0.1
Final a (in)	1.200	Kmax (ksi sqrt (in))	6.0
Pf (lbf)	1057		

Initial measured crack lengths (in)

1.160	1.176	1.187	1.195	1.205	1.214	1.221	1.223	1.214

Final measured crack lengths (in)

1.296	1.335	1.427	1.570	1.652	1.562	1.433	1.365	1.354
x	x		x	x	x		x	x

Ave. initial crack length (in)	1.201	aoq (in)	n/a
Ave. final crack length (in)	1.459	Compliance Adj. Factor	0.985
Delta a measured (in)	0.258	Effective Modulus (Msi)	10.3
Delta a predicted (in)	0.202		

Results

J_Q (E1820)	91.8 lbf-in/in^2
$K_{JIC}(E'*JQ)^{1/2}$	32.6 ksi sqrt(in)

Qualification of Data

7.4.2: precrack length	valid
9.1.4.1; precrack	valid
9.1.4.2; final crack	invalid
9.1.5.1; Δa meas	valid
9.1.5.2; Δa pred	invalid
A9.6.4; # of pnts in reg.A	valid
A9.6.4; # of pnts in reg.B	valid
A9.8.1; C_2<1	valid
A9.8.2.1; a_{0q}-a_0	#VALUE!
A9.8.2.2; # of pnts for J_Q	valid
A9.8.2.2; # of pnts < J_Q	valid
A9.3.3.1; correlation	valid

Qualification of J_Q as J_{IC}

A9.9.1; thickness	valid
A9.9.2; ligament	valid
A9.9.3; slope	valid

Index	Time	Force	Disp1	Disp2	Crack	Δa	CTOD	K561	K1820	KJ1820	J1820	Je	Jpl
	Sec	lbf	inch	inch	inch	inch	inch	ksi sqr(in)	ksi sqr(in)	ksi sqr(in)	lbf/in	lbf/in	lbf/in
9	419.3	846.7	0.01060	0.13367	1.2015	0.0000	0.00039	17.17	16.40	16.39	23.29	23.31	-0.03
10	456.3	961.8	0.01217	0.15167	1.2016	0.0001	0.00052	19.78	18.63	18.85	30.78	30.09	0.69
12	529.1	1180.7	0.01529	0.18616	1.2020	0.0005	0.00084	25.08	22.90	23.67	48.57	45.43	3.14
13	565.1	1282.8	0.01684	0.20142	1.2017	0.0002	0.00103	27.70	24.86	26.05	58.81	53.55	5.26
14	600.8	1379.2	0.01840	0.21729	1.2019	0.0004	0.00124	30.32	26.74	28.40	69.91	61.95	7.96
15	636.1	1470.5	0.01999	0.23163	1.2025	0.0010	0.00147	32.97	28.54	30.74	81.89	70.59	11.30
16	671.3	1547.7	0.02156	0.24322	1.2045	0.0030	0.00171	35.48	30.16	33.00	94.37	78.81	15.56
17	706	1611.2	0.02314	0.25421	1.2069	0.0054	0.00197	37.75	31.54	35.21	107.43	86.21	21.22
18	740.3	1657.3	0.02472	0.26062	1.2109	0.0094	0.00224	39.75	32.70	37.30	120.61	92.68	27.93
19	775	1697.8	0.02632	0.26642	1.2157	0.0142	0.00253	41.78	33.82	39.35	134.17	99.15	35.02
20	809.5	1731.3	0.02792	0.27252	1.2193	0.0178	0.00283	43.52	34.74	41.37	148.33	104.62	43.71
21	843.8	1754.8	0.02954	0.27557	1.2236	0.0221	0.00314	45.04	35.52	43.34	162.80	109.33	53.47
22	878.6	1785.3	0.03114	0.28046	1.2263	0.0248	0.00346	46.69	36.34	45.28	177.71	114.42	63.29
23	913.3	1801.0	0.03275	0.28320	1.2294	0.0279	0.00380	47.87	36.89	47.18	192.95	117.96	74.99
24	948.1	1817.8	0.03439	0.28778	1.2321	0.0306	0.00415	49.04	37.44	49.07	208.71	121.48	87.23
25	982.8	1827.6	0.03599	0.28839	1.2344	0.0329	0.00450	49.90	37.82	50.88	224.38	123.97	100.40
26	1017.8	1839.3	0.03762	0.28931	1.2360	0.0345	0.00486	50.71	38.19	52.70	240.66	126.38	114.28
27	1052.5	1831.1	0.03920	0.28992	1.2395	0.0380	0.00522	51.02	38.29	54.33	255.79	127.07	128.71
28	1087.6	1836.2	0.04081	0.28900	1.2421	0.0406	0.00558	51.76	38.60	55.96	271.44	129.16	142.28
29	1123	1846.9	0.04242	0.29144	1.2442	0.0427	0.00594	52.71	39.01	57.59	287.41	131.87	155.54
30	1158.2	1852.0	0.04403	0.29083	1.2460	0.0445	0.00631	53.32	39.25	59.19	303.66	133.55	170.11
31	1193.6	1848.8	0.04565	0.29175	1.2479	0.0464	0.00670	53.58	39.35	60.77	320.03	134.18	185.85
32	1228.9	1832.4	0.04728	0.28839	1.2516	0.0501	0.00709	53.57	39.30	62.20	335.34	133.88	201.46
33	1264.6	1836.2	0.04887	0.28992	1.2523	0.0508	0.00747	53.92	39.45	63.72	351.85	134.85	217.00
34	1300.1	1826.3	0.05043	0.28686	1.2549	0.0534	0.00785	53.99	39.45	65.08	367.01	134.85	232.16
35	1336	1826.9	0.05204	0.28748	1.2568	0.0553	0.00823	54.43	39.61	66.47	382.97	136.00	246.96
36	1372	1825.6	0.05363	0.28717	1.2588	0.0573	0.00861	54.82	39.75	67.82	398.64	136.97	261.67
37	1407.7	1811.2	0.05522	0.28534	1.2612	0.0597	0.00900	54.64	39.65	69.12	414.00	136.24	277.76
38	1444.1	1802.2	0.05682	0.28259	1.2638	0.0623	0.00940	54.75	39.67	70.37	429.12	136.36	292.76
39	1480.4	1787.1	0.05844	0.28107	1.2662	0.0647	0.00980	54.53	39.54	71.61	444.45	135.53	308.93
40	1516.7	1776.9	0.06002	0.28015	1.2690	0.0675	0.01020	54.63	39.55	72.77	459.00	135.58	323.42
41	1553.6	1768.7	0.06162	0.27832	1.2721	0.0706	0.01059	54.92	39.64	73.90	473.31	136.18	337.13
42	1590.5	1755.7	0.06320	0.27740	1.2737	0.0722	0.01100	54.60	39.48	75.09	488.73	135.12	353.61
43	1627.4	1735.7	0.06481	0.27283	1.2775	0.0760	0.01141	54.41	39.36	76.12	502.21	134.26	367.95
44	1664.7	1718.8	0.06645	0.27039	1.2803	0.0788	0.01184	54.14	39.21	77.22	516.81	133.26	383.55
45	1702.4	1708.1	0.06806	0.26917	1.2841	0.0826	0.01225	54.46	39.30	78.19	529.85	133.86	395.99
46	1740.1	1699.4	0.06965	0.26703	1.2868	0.0853	0.01265	54.62	39.34	79.21	543.71	134.10	409.61
47	1778.2	1692.5	0.07127	0.26703	1.2900	0.0885	0.01306	54.99	39.45	80.19	557.29	134.89	422.40
48	1816.2	1676.5	0.07284	0.26367	1.2928	0.0913	0.01348	54.76	39.32	81.15	570.71	134.01	436.70
49	1854.7	1656.2	0.07443	0.26215	1.2988	0.0973	0.01390	55.07	39.38	81.85	580.61	134.37	446.25
50	1893.5	1636.8	0.07604	0.25757	1.3012	0.0997	0.01434	54.54	39.13	82.83	594.61	132.67	461.93
51	1932.6	1621.1	0.07766	0.25574	1.3041	0.1026	0.01478	54.35	39.01	83.74	607.74	131.89	475.85
52	1971.9	1601.6	0.07926	0.25146	1.3083	0.1068	0.01522	54.24	38.92	84.52	619.07	131.25	487.82
53	2011.6	1589.1	0.08083	0.24994	1.3120	0.1105	0.01564	54.41	38.94	85.29	630.46	131.42	499.04
54	2051.4	1554.6	0.08252	0.24567	1.3171	0.1156	0.01613	53.61	38.55	86.02	641.33	128.76	512.57
55	2092.1	1544.7	0.08409	0.24445	1.3207	0.1192	0.01656	53.91	38.62	86.76	652.40	129.29	523.11
56	2132.4	1510.6	0.08570	0.23865	1.3262	0.1247	0.01704	53.20	38.26	87.36	661.38	126.88	534.49
57	2173.7	1500.4	0.08727	0.23590	1.3297	0.1282	0.01747	53.45	38.32	88.06	672.08	127.29	544.79
58	2215.2	1480.1	0.08886	0.23346	1.3342	0.1327	0.01792	53.30	38.21	88.69	681.73	126.51	555.22
59	2257.4	1461.6	0.09053	0.23071	1.3375	0.1360	0.01840	52.98	38.03	89.45	693.41	125.36	568.05
60	2299.7	1442.9	0.09219	0.22797	1.3426	0.1411	0.01888	53.09	38.01	90.02	702.31	125.22	577.08
61	2342.5	1426.1	0.09380	0.22614	1.3466	0.1451	0.01934	53.02	37.94	90.64	712.00	124.73	587.27
62	2385.7	1413.0	0.09536	0.22339	1.3496	0.1481	0.01979	52.93	37.86	91.31	722.58	124.23	598.36
63	2428.9	1395.0	0.09691	0.22156	1.3530	0.1515	0.02025	52.62	37.69	91.93	732.35	123.12	609.24
64	2472.7	1367.7	0.09851	0.21667	1.3586	0.1571	0.02074	52.25	37.47	92.35	739.07	121.67	617.41
65	2517.1	1350.6	0.10008	0.21362	1.3631	0.1616	0.02121	52.29	37.42	92.83	746.81	121.38	625.43

Index	Time	Force	Disp1	Disp2	Crack	Δa	CTOD	K561	K1820	KJ1820	J1820	Je	Jpl
	Sec	lbf	inch	inch	inch	inch	inch	ksi sqr(in)	ksi sqr(in)	ksi sqr(in)	lbf/in	lbf/in	lbf/in
66	2562.1	1328.0	0.10175	0.21271	1.3681	0.1666	0.02172	52.05	37.26	93.31	754.51	120.35	634.16
67	2607.4	1308.8	0.10331	0.20752	1.3725	0.1710	0.02220	51.87	37.14	93.77	761.99	119.52	642.48
68	2653.4	1292.9	0.10490	0.20538	1.3773	0.1758	0.02268	52.02	37.13	94.19	768.90	119.50	649.40
69	2699.9	1268.8	0.10653	0.20142	1.3825	0.1810	0.02319	51.69	36.93	94.58	775.29	118.20	657.08
70	2747.2	1242.7	0.10818	0.19867	1.3883	0.1868	0.02373	51.36	36.72	94.90	780.59	116.88	663.71
71	2795.1	1231.4	0.10975	0.19562	1.3926	0.1911	0.02420	51.68	36.80	95.32	787.38	117.36	670.02
72	2843.2	1208.9	0.11136	0.19257	1.3971	0.1956	0.02472	51.24	36.56	95.72	794.05	115.85	678.21
73	2892.6	1198.4	0.11293	0.19073	1.4005	0.1990	0.02519	51.40	36.58	96.19	801.81	115.96	685.85
74	2942.2	1190.9	0.11448	0.18982	1.4036	0.2021	0.02564	51.67	36.65	96.68	810.04	116.39	693.66

Elastic-Plastic Fracture Toughness Analysis

Specimen ID	5083-FT-3	Geometry	C(T)
Contract	SSC 10624-01	Orientation	T-L
Material	5083-H321	Yield (ksi)	34.3
Temperature(F)	75.0	Tensile (ksi)	51.8
Environment	LAB AIR	Modulus (Msi)	10.5

Specimen Dimensions

Thickness (in)	0.500	Notch Depth (in)	1.100
Net Thickness (in)	0.395	Gage Length (in)	0.200
Width (in)	2.000	Alpha Ratio	1
Pin Spacing (in)	1.100		

Precrack Parameters

Pmax (lbf)	310.9	Stress Ratio	0.1
Final a (in)	1.200	Kmax (ksi sqrt (in))	6.0
Pf (lbf)	1053		

Initial measured crack lengths (in)

1.211	1.213	1.211	1.207	1.204	1.199	1.197	1.192	1.186

Final measured crack lengths (in)

1.422	1.423	1.429	1.421	1.416	1.414	1.398	1.395	1.397

Ave. initial crack length (in)	1.203	aoq (in)	1.204
Ave. final crack length (in)	1.413	Compliance Adj. Factor	1.019
Delta a measured (in)	0.210	Effective Modulus (Msi)	10.7
Delta a predicted (in)	0.199		

Results

J_Q (E1820)	111.4 lbf-in/in^2
K_{JIC}(E'*JQ)^1/2	35.9 ksi sqrt(in)

Qualification of Data		Qualification of J_Q as J_{IC}	
7.4.2: precrack length	valid		
9.1.4.1; precrack	valid	A9.9.1; thickness	valid
9.1.4.2; final crack	valid	A9.9.2; ligament	valid
9.1.5.1; Δa meas	valid	A9.9.3; slope	valid
9.1.5.2; Δa pred	valid		
A9.6.4; # of pnts in reg.A	valid		
A9.6.4; # of pnts in reg.B	valid		
A9.8.1; C_2<1	valid		
A9.8.2.1; a_{0Q}-a_0	valid		
A9.8.2.2; # of pnts for J_Q	invalid		
A9.8.2.2; # of pnts < J_Q	valid		
A9.3.3.1; correlation	valid		

Index	Time	Force	Disp1	Disp2	Crack	Δa	CTOD	K561	K1820	KJ1820	J1820	Je	Jpl
	Sec	lbf	inch	inch	inch	inch	inch	ksi sqr(in)	ksi sqr(in)	ksi sqr(in)	lbf/in	lbf/in	lbf/in
10	380.8	304.3	0.00371	0.04822	1.2029	-0.0014	0.00004	6.70	6.65	6.65	3.84	3.83	0.01
11	430.1	388.2	0.00477	0.06165	1.2027	-0.0015	0.00007	8.58	8.48	8.50	6.27	6.23	0.04
12	462.8	471.2	0.00583	0.07416	1.2031	-0.0011	0.00012	10.49	10.30	10.34	9.26	9.20	0.06
13	495.1	554.5	0.00687	0.08698	1.2041	-0.0002	0.00017	12.45	12.15	12.15	12.80	12.78	0.01
14	526	638.0	0.00793	0.10071	1.2043	0.0001	0.00023	14.46	13.98	14.00	17.00	16.94	0.06
15	556.1	719.9	0.00898	0.11383	1.2047	0.0004	0.00030	16.48	15.79	15.81	21.67	21.60	0.07
16	586.1	800.9	0.01002	0.12604	1.2049	0.0006	0.00038	18.53	17.57	17.63	26.95	26.76	0.19
17	616.1	882.9	0.01108	0.13916	1.2051	0.0008	0.00047	20.68	19.37	19.47	32.85	32.53	0.32
18	645.8	960.5	0.01213	0.15137	1.2053	0.0011	0.00058	22.79	21.09	21.29	39.28	38.55	0.73
19	675.1	1031.2	0.01318	0.16296	1.2063	0.0021	0.00069	24.83	22.69	23.10	46.23	44.61	1.63
20	704.3	1099.4	0.01424	0.17334	1.2052	0.0010	0.00084	26.73	24.13	24.95	53.94	50.48	3.47
21	733.3	1166.2	0.01531	0.18372	1.2064	0.0022	0.00097	28.83	25.66	26.73	61.92	57.08	4.84
22	762.1	1228.5	0.01638	0.19318	1.2067	0.0024	0.00113	30.80	27.05	28.53	70.52	63.39	7.13
23	790.6	1286.3	0.01743	0.20264	1.2072	0.0029	0.00129	32.72	28.35	30.27	79.41	69.64	9.78
24	819.3	1341.9	0.01851	0.21210	1.2090	0.0048	0.00145	34.78	29.68	31.98	88.66	76.34	12.32
25	847.8	1394.0	0.01958	0.21912	1.2103	0.0061	0.00163	36.76	30.91	33.70	98.41	82.83	15.58
26	876.1	1435.6	0.02065	0.22614	1.2126	0.0084	0.00181	38.54	31.98	35.35	108.30	88.63	19.66
27	904.5	1470.5	0.02173	0.23071	1.2161	0.0118	0.00200	40.31	32.99	36.96	118.37	94.30	24.07
28	932.6	1498.4	0.02282	0.23682	1.2200	0.0157	0.00219	41.94	33.88	38.52	128.57	99.46	29.11
29	960.8	1514.1	0.02392	0.23895	1.2263	0.0221	0.00239	43.49	34.67	39.98	138.55	104.19	34.36
30	989.1	1523.4	0.02502	0.23926	1.2334	0.0292	0.00258	44.98	35.40	41.36	148.28	108.59	39.69
31	1017.3	1514.0	0.02606	0.23834	1.2411	0.0369	0.00279	45.78	35.74	42.62	157.45	110.71	46.73
32	1045.7	1500.8	0.02714	0.23560	1.2519	0.0476	0.00298	46.97	36.24	43.73	165.77	113.81	51.95
33	1074.2	1460.1	0.02821	0.22919	1.2654	0.0612	0.00318	47.33	36.29	44.68	173.00	114.11	58.88
34	1103.9	1418.9	0.02933	0.22308	1.2815	0.0772	0.00338	48.14	36.52	45.50	179.46	115.57	63.88
35	1133.9	1365.8	0.03040	0.21576	1.2975	0.0932	0.00359	48.30	36.43	46.22	185.14	115.01	70.13
36	1165.6	1344.0	0.03146	0.21179	1.3088	0.1046	0.00379	49.33	36.78	47.08	192.06	117.27	74.79
37	1197.6	1283.0	0.03259	0.20233	1.3264	0.1221	0.00402	49.32	36.58	47.68	197.03	115.99	81.04
38	1230.9	1215.1	0.03380	0.19135	1.3459	0.1417	0.00428	49.19	36.31	48.21	201.47	114.26	87.21
39	1266.6	1201.2	0.03487	0.18890	1.3554	0.1511	0.00449	50.43	36.74	49.00	208.08	116.96	91.12
40	1302.6	1162.3	0.03599	0.18372	1.3679	0.1637	0.00473	50.65	36.68	49.67	213.78	116.60	97.18
41	1339.4	1099.8	0.03718	0.17365	1.3853	0.1810	0.00501	50.23	36.29	50.10	217.54	114.12	103.42
42	1378	1052.1	0.03831	0.16632	1.4024	0.1981	0.00524	50.82	36.31	50.40	220.16	114.28	105.87

Elastic-Plastic Fracture Toughness Analysis

Specimen ID	5083-FT-5	Geometry	C(T)
Contract	SSC 10624-01	Orientation	T-L
Material	5083-H321	Yield (ksi)	34.3
Temperature(F)	75.0	Tensile (ksi)	51.8
Environment	LAB AIR	Modulus (Msi)	10.5

Specimen Dimensions

Thickness (in)	0.501	Notch Depth (in)	2.200
Net Thickness (in)	0.501	Gage Length (in)	0.200
Width (in)	4.000	Alpha Ratio	1
Pin Spacing (in)	2.200		

Precrack Parameters

Pmax (lbf)	733.0	Stress Ratio	0.1
Final a (in)	2.400	Kmax (ksi sqrt (in))	9.9
Pf (lbf)	2158		

Initial measured crack lengths (in)

2.340	2.365	2.382	2.394	2.401	2.404	2.403	2.395	2.375

Final measured crack lengths (in)

2.484	2.531	2.617	2.754	2.815	2.719	2.596	2.548	2.519
x				x				

Ave. initial crack length (in)	2.388	aoq (in)	2.391
Ave. final crack length (in)	2.635	Compliance Adj. Factor	0.985
Delta a measured (in)	0.247	Effective Modulus (Msi)	10.3
Delta a predicted (in)	0.213		

Results

J_Q (E1820)	146.9 lbf-in/in^2
K_{JIC}(E'*JQ)^1/2	41.2 ksi sqrt(in)

Qualification of Data		Qualification of J_Q as J_{IC}	
7.4.2: precrack length	valid		
9.1.4.1; precrack	valid	A9.9.1; thickness	valid
9.1.4.2; final crack	invalid	A9.9.2; ligament	valid
9.1.5.1; Δa meas	valid	A9.9.3; slope	valid
9.1.5.2; Δa pred	valid		
A9.6.4; # of pnts in reg.A	valid		
A9.6.4; # of pnts in reg.B	valid		
A9.8.1; C_2<1	valid		
A9.8.2.1; a_{0Q}-a_0	valid		
A9.8.2.2; # of pnts for J_Q	valid		
A9.8.2.2; # of pnts < J_Q	valid		
A9.3.3.1; correlation	valid		

Index	Time	Force	Disp1	Disp2	Crack	Δa	CTOD	K561	K1820	KJ1820	J1820	Je	Jpl
	Sec	lbf	inch	inch	inch	inch	inch	ksi sqr(in)	ksi sqr(in)	ksi sqr(in)	lbf/in	lbf/in	lbf/in
20	704.3	2535.4	0.03334	0.83618	2.3892	-0.0016	0.00215	37.85	34.21	34.12	100.90	101.40	-0.51
21	735.6	2647.3	0.03551	0.87647	2.3903	-0.0004	0.00247	39.95	35.76	36.54	115.73	110.80	4.94
22	767.1	2742.0	0.03770	0.90912	2.3957	0.0050	0.00279	42.03	37.23	38.86	130.86	120.13	10.73
23	798.3	2838.8	0.03990	0.93842	2.3984	0.0076	0.00314	44.06	38.64	41.18	146.95	129.42	17.53
24	829.5	2921.9	0.04205	0.96436	2.4010	0.0103	0.00350	45.89	39.88	43.40	163.26	137.83	25.43
25	860.8	2997.1	0.04423	0.99121	2.4051	0.0144	0.00387	47.71	41.07	45.57	179.99	146.19	33.80
26	892.3	3076.8	0.04639	1.02051	2.4082	0.0175	0.00424	49.62	42.29	47.70	197.18	155.00	42.19
27	923.6	3151.1	0.04857	1.04370	2.4093	0.0186	0.00464	51.32	43.36	49.85	215.39	162.93	52.47
28	954.8	3215.2	0.05074	1.06720	2.4124	0.0216	0.00504	52.99	44.37	51.91	233.55	170.66	62.89
29	986	3273.0	0.05292	1.08612	2.4138	0.0231	0.00546	54.44	45.24	53.97	252.47	177.36	75.10
30	1017.5	3328.3	0.05510	1.10169	2.4144	0.0237	0.00590	55.78	46.03	56.02	272.01	183.62	88.40
31	1048.9	3380.1	0.05728	1.12396	2.4166	0.0259	0.00633	57.22	46.85	57.99	291.49	190.22	101.28
32	1080.5	3429.7	0.05947	1.13251	2.4191	0.0283	0.00677	58.65	47.65	59.92	311.21	196.79	114.43
33	1111.7	3475.9	0.06165	1.15051	2.4207	0.0300	0.00721	59.97	48.37	61.84	331.46	202.80	128.66
34	1143.1	3511.5	0.06387	1.16455	2.4225	0.0318	0.00768	61.05	48.96	63.76	352.30	207.72	144.58
35	1174.4	3541.9	0.06608	1.17584	2.4254	0.0347	0.00815	62.13	49.52	65.59	372.88	212.53	160.34
36	1205.7	3574.4	0.06830	1.18622	2.4285	0.0378	0.00861	63.31	50.13	67.39	393.56	217.81	175.74
37	1237.1	3586.4	0.07051	1.18591	2.4312	0.0405	0.00911	63.92	50.43	69.17	414.69	220.44	194.24
38	1268.5	3595.1	0.07272	1.19049	2.4362	0.0455	0.00959	64.71	50.81	70.83	434.82	223.77	211.05
39	1300	3609.6	0.07493	1.20178	2.4376	0.0469	0.01009	65.26	51.09	72.57	456.47	226.22	230.26
40	1331.6	3620.6	0.07714	1.19751	2.4419	0.0511	0.01058	66.05	51.46	74.19	477.06	229.54	247.52
41	1363.4	3627.2	0.07940	1.20575	2.4447	0.0540	0.01110	66.57	51.71	75.86	498.74	231.71	267.03
42	1395.1	3634.9	0.08163	1.20392	2.4498	0.0591	0.01159	67.39	52.08	77.40	519.23	235.10	284.13
43	1427	3634.9	0.08386	1.20575	2.4547	0.0640	0.01210	67.99	52.35	78.91	539.67	237.48	302.19
44	1459.1	3641.4	0.08607	1.21002	2.4565	0.0658	0.01261	68.40	52.53	80.50	561.57	239.19	322.38
45	1491.1	3626.9	0.08829	1.20056	2.4626	0.0719	0.01313	68.73	52.65	81.90	581.26	240.27	340.99
46	1523.1	3630.2	0.09053	1.20087	2.4648	0.0741	0.01366	69.10	52.82	83.43	603.26	241.78	361.48
47	1555.7	3624.4	0.09276	1.20422	2.4698	0.0791	0.01418	69.56	53.01	84.82	623.58	243.49	380.09
48	1588.2	3612.4	0.09497	1.19934	2.4742	0.0834	0.01471	69.76	53.07	86.20	643.98	244.07	399.91
49	1621	3599.6	0.09724	1.18957	2.4803	0.0896	0.01525	70.16	53.22	87.52	663.83	245.43	418.40
50	1653.6	3563.2	0.09945	1.17706	2.4855	0.0948	0.01581	69.71	52.97	88.81	683.52	243.14	440.37
51	1686.9	3561.9	0.10166	1.18317	2.4902	0.0995	0.01633	70.29	53.21	90.08	703.32	245.34	457.98
52	1720	3543.1	0.10388	1.17188	2.4944	0.1037	0.01689	70.25	53.16	91.37	723.54	244.91	478.64
53	1753.4	3534.7	0.10614	1.17401	2.4981	0.1074	0.01744	70.48	53.24	92.67	744.31	245.65	498.66
54	1787.1	3520.2	0.10837	1.16882	2.5040	0.1133	0.01798	70.82	53.35	93.84	763.20	246.70	516.50
55	1821	3510.3	0.11057	1.16303	2.5087	0.1179	0.01852	71.13	53.46	95.02	782.53	247.71	534.82
56	1854.7	3494.0	0.11274	1.15601	2.5150	0.1243	0.01905	71.47	53.57	96.09	800.22	248.75	551.47
57	1889	3482.1	0.11497	1.15753	2.5204	0.1297	0.01960	71.83	53.70	97.22	819.07	249.89	569.19
58	1923	3461.9	0.11717	1.14532	2.5262	0.1355	0.02016	71.98	53.72	98.29	837.30	250.12	587.18
59	1957.5	3431.9	0.11938	1.14014	2.5328	0.1421	0.02073	71.89	53.63	99.31	854.82	249.29	605.53
60	1992.4	3426.1	0.12157	1.13831	2.5373	0.1466	0.02127	72.35	53.80	100.40	873.55	250.88	622.67
61	2027.4	3394.0	0.12382	1.12244	2.5448	0.1541	0.02186	72.32	53.73	101.37	890.49	250.23	640.26
62	2062.9	3377.7	0.12607	1.11542	2.5500	0.1593	0.02243	72.51	53.78	102.41	909.00	250.65	658.35
63	2098.2	3355.3	0.12828	1.11206	2.5552	0.1644	0.02301	72.48	53.72	103.43	927.07	250.15	676.92
64	2133.9	3334.2	0.13052	1.10596	2.5615	0.1708	0.02359	72.67	53.76	104.38	944.27	250.48	693.79
65	2169.9	3320.9	0.13270	1.10413	2.5673	0.1766	0.02415	73.07	53.89	105.31	961.07	251.71	709.36
66	2206.1	3294.5	0.13489	1.08948	2.5740	0.1833	0.02473	73.12	53.86	106.18	977.08	251.43	725.65
67	2242.4	3254.9	0.13708	1.07819	2.5794	0.1887	0.02534	72.48	53.54	107.11	994.23	248.39	745.84
68	2279.4	3239.0	0.13927	1.07849	2.5864	0.1957	0.02591	72.96	53.69	107.92	1009.45	249.85	759.60
69	2316.4	3205.9	0.14149	1.05743	2.5940	0.2033	0.02652	72.89	53.60	108.72	1024.31	248.97	775.34
70	2353.6	3164.8	0.14371	1.04584	2.6026	0.2119	0.02715	72.66	53.43	109.44	1038.01	247.40	790.61

Elastic-Plastic Fracture Toughness Analysis

Specimen ID	5086-FT-1	**Geometry**	C(T)
Contract	SSC 10624-01	**Orientation**	T-L
Material	5086-H116	**Yield (ksi)**	27.0
Temperature(F)	75.0	**Tensile (ksi)**	46.0
Environment	LAB AIR	**Modulus (Msi)**	10.5

Specimen Dimensions

Thickness (in)	0.496	**Notch Depth (in)**	1.100
Net Thickness (in)	0.496	**Gage Length (in)**	0.200
Width (in)	2.000	**Alpha Ratio**	1
Pin Spacing (in)	1.100		

Precrack Parameters

Pmax (lbf)	308.4	**Stress Ratio**	0.1
Final a (in)	1.200	**Kmax (ksi sqrt (in))**	6.0
Pf (lbf)	887		

Initial measured crack lengths (in)

1.172	1.189	1.200	1.204	1.208	1.212	1.213	1.207	1.197

Final measured crack lengths (in)

1.324	1.358	1.451	1.566	1.647	1.547	1.426	1.354	1.338
x	x		x	x	x		x	x

Ave. initial crack length (in)	1.202	**aoq (in)**	1.201
Ave. final crack length (in)	1.460	**Compliance Adj. Factor**	0.995
Delta a measured (in)	0.258	**Effective Modulus (Msi)**	10.4
Delta a predicted (in)	0.200		

Results

J_Q (E1820)	155.4 lbf-in/in^2
K_{JIC}(E'*JQ)^1/2	42.3 ksi sqrt(in)

Qualification of Data

7.4.2: precrack length	valid
9.1.4.1; precrack	valid
9.1.4.2; final crack	invalid
9.1.5.1; Δa meas	valid
9.1.5.2; Δa pred	invalid
A9.6.4; # of pnts in reg.A	valid
A9.6.4; # of pnts in reg.B	valid
A9.8.1; C_2<1	valid
A9.8.2.1; a_{0Q}-a_0	valid
A9.8.2.2; # of pnts for J_Q	valid
A9.8.2.2; # of pnts < J_Q	valid
A9.3.3.1; correlation	valid

Qualification of J_Q as J_{IC}

A9.9.1; thickness	valid
A9.9.2; ligament	valid
A9.9.3; slope	valid

Index	Time	Force	Disp1	Disp2	Crack	Δa	CTOD	K561	K1820	KJ1820	J1820	Je	Jpl
	Sec	lbf	inch	inch	inch	inch	inch	ksi sqr(in)	ksi sqr(in)	ksi sqr(in)	lbf/in	lbf/in	lbf/in
5	238.6	353.5	0.00415	0.05585	1.2025	0.0016	0.00003	6.99	6.91	6.92	4.15	4.14	0.01
6	310.3	476.7	0.00569	0.07538	1.2015	0.0007	0.00010	9.49	9.30	9.36	7.59	7.49	0.10
7	350.6	598.8	0.00725	0.09399	1.2024	0.0016	0.00020	12.09	11.70	11.83	12.12	11.86	0.26
8	389.1	716.1	0.00882	0.11322	1.2017	0.0008	0.00032	14.64	13.97	14.29	17.70	16.92	0.78
9	426.7	828.7	0.01039	0.13092	1.2027	0.0018	0.00047	17.25	16.20	16.71	24.21	22.75	1.47
10	464.2	937.8	0.01196	0.14831	1.2025	0.0016	0.00064	19.87	18.32	19.14	31.74	29.10	2.64
11	500.8	1039.3	0.01354	0.16327	1.2026	0.0018	0.00084	22.46	20.31	21.53	40.19	35.77	4.42
12	537.3	1133.7	0.01509	0.17853	1.2012	0.0004	0.00107	24.90	22.10	23.89	49.46	42.33	7.13
13	573.6	1219.2	0.01665	0.19287	1.2010	0.0001	0.00131	27.29	23.75	26.20	59.49	48.90	10.59
14	609.1	1298.7	0.01824	0.20386	1.2016	0.0007	0.00157	29.70	25.33	28.48	70.32	55.62	14.70
15	644.3	1365.5	0.01981	0.21545	1.2025	0.0016	0.00185	31.88	26.68	30.68	81.57	61.71	19.86
16	679.6	1424.7	0.02139	0.22430	1.2021	0.0013	0.00215	33.79	27.82	32.89	93.74	67.08	26.66
17	714.3	1477.1	0.02298	0.23254	1.2027	0.0019	0.00245	35.65	28.88	35.02	106.31	72.27	34.04
18	749.1	1519.8	0.02459	0.23926	1.2038	0.0030	0.00278	37.31	29.78	37.11	119.38	76.84	42.54
19	783.6	1558.1	0.02620	0.24536	1.2045	0.0037	0.00311	38.82	30.57	39.16	132.93	81.00	51.93
20	817.8	1589.4	0.02779	0.24902	1.2056	0.0048	0.00344	40.17	31.25	41.12	146.51	84.64	61.87
21	852	1614.4	0.02940	0.25482	1.2078	0.0069	0.00378	41.47	31.88	42.99	160.21	88.08	72.13
22	886.1	1630.7	0.03101	0.25604	1.2089	0.0081	0.00413	42.31	32.27	44.86	174.42	90.27	84.15
23	920.3	1646.1	0.03264	0.26001	1.2116	0.0108	0.00449	43.38	32.76	46.63	188.43	92.99	95.44
24	954.3	1652.5	0.03424	0.25909	1.2139	0.0131	0.00485	44.01	33.03	48.34	202.49	94.56	107.93
25	988.8	1660.8	0.03586	0.26032	1.2158	0.0149	0.00521	44.68	33.32	50.02	216.84	96.22	120.61
26	1022.8	1663.7	0.03747	0.26123	1.2184	0.0175	0.00557	45.25	33.55	51.61	230.88	97.57	133.31
27	1057.2	1665.0	0.03908	0.26306	1.2209	0.0201	0.00594	45.76	33.76	53.17	245.00	98.75	146.25
28	1091.7	1672.8	0.04069	0.26215	1.2232	0.0224	0.00630	46.53	34.07	54.69	259.19	100.59	158.60
29	1126.1	1673.9	0.04231	0.26367	1.2239	0.0231	0.00668	46.72	34.14	56.26	274.35	101.02	173.33
30	1160.6	1671.3	0.04392	0.26367	1.2268	0.0260	0.00705	47.13	34.29	57.67	288.24	101.90	186.34
31	1195.2	1678.5	0.04555	0.26337	1.2281	0.0272	0.00743	47.71	34.52	59.15	303.21	103.30	199.91
32	1229.9	1675.1	0.04717	0.26337	1.2298	0.0290	0.00781	47.88	34.58	60.56	317.82	103.61	214.20
33	1264.6	1673.9	0.04878	0.26276	1.2314	0.0306	0.00819	48.13	34.67	61.93	332.36	104.15	228.20
34	1299.6	1672.5	0.05039	0.26215	1.2322	0.0314	0.00858	48.22	34.69	63.32	347.46	104.32	243.14
35	1334.6	1666.4	0.05201	0.26215	1.2346	0.0337	0.00896	48.38	34.74	64.59	361.51	104.57	256.94
36	1369.6	1663.5	0.05360	0.26092	1.2374	0.0365	0.00934	48.79	34.88	65.78	375.00	105.42	269.58
37	1404.9	1664.4	0.05522	0.26092	1.2380	0.0372	0.00973	48.96	34.94	67.10	390.19	105.80	284.39
38	1440.1	1661.4	0.05682	0.26062	1.2391	0.0382	0.01011	49.02	34.95	68.35	404.93	105.87	299.06
39	1475.6	1657.7	0.05843	0.26032	1.2411	0.0402	0.01050	49.25	35.02	69.53	418.96	106.30	312.65
40	1510.7	1648.4	0.06004	0.25848	1.2430	0.0422	0.01089	49.16	34.97	70.69	433.03	105.97	327.05
41	1546.5	1644.3	0.06167	0.25940	1.2454	0.0445	0.01129	49.43	35.05	71.81	446.92	106.46	340.45
42	1582.2	1641.2	0.06329	0.25848	1.2466	0.0458	0.01169	49.53	35.08	72.97	461.45	106.64	354.81
43	1618	1633.9	0.06488	0.25726	1.2480	0.0471	0.01208	49.42	35.02	74.08	475.64	106.29	369.35
44	1654	1626.4	0.06650	0.25665	1.2491	0.0483	0.01248	49.26	34.94	75.21	490.24	105.83	384.41
45	1690	1619.3	0.06813	0.25452	1.2517	0.0509	0.01288	49.42	34.98	76.22	503.49	106.04	397.44
46	1726.1	1615.8	0.06972	0.25452	1.2529	0.0520	0.01327	49.48	34.99	77.28	517.62	106.11	411.51
47	1762.5	1614.5	0.07131	0.25574	1.2544	0.0535	0.01366	49.73	35.07	78.30	531.39	106.61	424.78
48	1798.7	1608.0	0.07290	0.25360	1.2572	0.0564	0.01407	49.99	35.14	79.21	543.83	107.04	436.79
49	1835.1	1600.7	0.07453	0.25116	1.2585	0.0577	0.01448	49.86	35.08	80.25	558.18	106.65	451.53
50	1871.9	1598.4	0.07614	0.25146	1.2599	0.0590	0.01487	50.03	35.13	81.25	572.16	106.95	465.21
51	1908.6	1595.3	0.07775	0.25146	1.2616	0.0607	0.01528	50.23	35.19	82.21	585.71	107.33	478.39
52	1945.1	1590.9	0.07937	0.24963	1.2635	0.0627	0.01569	50.42	35.24	83.14	599.03	107.63	491.40
53	1982	1586.5	0.08099	0.24933	1.2647	0.0639	0.01609	50.44	35.23	84.11	613.12	107.60	505.53
54	2018.7	1577.2	0.08260	0.24872	1.2664	0.0655	0.01650	50.27	35.15	85.03	626.60	107.09	519.51
55	2055.6	1573.0	0.08416	0.24780	1.2678	0.0670	0.01690	50.36	35.17	85.92	639.78	107.21	532.58
56	2092.9	1570.1	0.08577	0.24689	1.2692	0.0683	0.01731	50.50	35.21	86.83	653.45	107.43	546.02
57	2130.1	1555.9	0.08739	0.24445	1.2714	0.0705	0.01773	50.17	35.06	87.67	666.12	106.51	559.61
58	2167.4	1544.9	0.08901	0.24353	1.2741	0.0732	0.01816	50.14	35.01	88.46	678.13	106.25	571.87
59	2204.9	1535.9	0.09066	0.24322	1.2764	0.0755	0.01860	50.13	34.98	89.27	690.70	106.07	584.63
60	2242.4	1524.8	0.09228	0.24139	1.2786	0.0777	0.01903	49.98	34.90	90.07	703.02	105.56	597.45

Index	Time	Force	Disp1	Disp2	Crack	Δa	CTOD	K561	K1820	KJ1820	J1820	Je	Jpl
	Sec	lbf	inch	inch	inch	inch	inch	ksi sqr(in)	ksi sqr(in)	ksi sqr(in)	lbf/in	lbf/in	lbf/in
61	2280.4	1513.5	0.09388	0.23773	1.2816	0.0808	0.01946	50.00	34.87	90.77	713.99	105.40	608.59
62	2318.4	1500.2	0.09545	0.23773	1.2845	0.0837	0.01989	49.86	34.79	91.45	724.78	104.89	619.89
63	2356.6	1485.8	0.09706	0.23438	1.2874	0.0866	0.02033	49.65	34.68	92.14	735.70	104.21	631.49
64	2395.2	1479.3	0.09864	0.23438	1.2901	0.0892	0.02075	49.87	34.73	92.82	746.62	104.54	642.09
65	2433.9	1471.1	0.10023	0.23254	1.2921	0.0913	0.02118	49.84	34.70	93.54	758.33	104.33	654.00
66	2472.9	1460.9	0.10180	0.23254	1.2939	0.0930	0.02160	49.62	34.59	94.27	770.25	103.69	666.57
67	2512.1	1448.7	0.10342	0.22919	1.2979	0.0970	0.02206	49.80	34.61	94.82	779.20	103.83	675.37
68	2551.6	1440.0	0.10501	0.22766	1.3001	0.0992	0.02250	49.77	34.58	95.50	790.41	103.62	686.79
69	2591.2	1428.2	0.10662	0.22675	1.3021	0.1013	0.02294	49.52	34.46	96.19	801.91	102.89	699.02
70	2631.1	1412.2	0.10825	0.22430	1.3067	0.1058	0.02342	49.56	34.42	96.66	809.76	102.69	707.07
71	2671.2	1399.4	0.10984	0.22339	1.3086	0.1077	0.02386	49.19	34.26	97.34	821.10	101.72	719.39
72	2711.7	1392.5	0.11146	0.22125	1.3106	0.1098	0.02431	49.24	34.25	97.99	832.24	101.68	730.56
73	2752.2	1383.1	0.11304	0.21942	1.3138	0.1129	0.02476	49.38	34.27	98.52	841.26	101.78	739.48
74	2793.1	1374.5	0.11463	0.21912	1.3163	0.1154	0.02520	49.41	34.25	99.11	851.36	101.69	749.67
75	2834.2	1366.6	0.11621	0.21790	1.3187	0.1178	0.02565	49.48	34.25	99.69	861.37	101.66	759.71
76	2875.6	1351.2	0.11784	0.21515	1.3222	0.1213	0.02613	49.29	34.14	100.19	870.01	101.00	769.00
77	2916.9	1339.7	0.11942	0.21393	1.3259	0.1250	0.02660	49.43	34.15	100.63	877.64	101.04	776.59
78	2958.9	1324.9	0.12098	0.21210	1.3289	0.1280	0.02706	49.17	34.01	101.11	886.09	100.26	785.84
79	3001.2	1309.5	0.12260	0.20843	1.3325	0.1316	0.02755	49.00	33.91	101.56	893.96	99.63	794.33
80	3043.9	1298.8	0.12417	0.20721	1.3357	0.1349	0.02802	49.06	33.89	102.01	901.82	99.54	802.28
81	3086.9	1286.9	0.12577	0.20508	1.3387	0.1378	0.02850	48.96	33.82	102.49	910.33	99.12	811.20
82	3130.1	1273.3	0.12739	0.20355	1.3420	0.1411	0.02899	48.83	33.73	102.94	918.30	98.60	819.70
83	3173.7	1262.5	0.12896	0.20294	1.3442	0.1434	0.02945	48.63	33.63	103.45	927.50	98.00	829.51
84	3217.7	1255.8	0.13056	0.20203	1.3476	0.1467	0.02992	48.98	33.72	103.86	934.93	98.54	836.39
85	3261.9	1247.7	0.13214	0.20050	1.3499	0.1491	0.03039	49.00	33.70	104.36	943.91	98.41	845.50
86	3306.4	1236.9	0.13375	0.19836	1.3530	0.1521	0.03088	48.98	33.65	104.79	951.77	98.16	853.61
87	3351.4	1232.2	0.13532	0.19714	1.3546	0.1537	0.03133	49.04	33.66	105.35	961.87	98.19	863.68
88	3396.4	1219.8	0.13692	0.19562	1.3569	0.1561	0.03181	48.74	33.52	105.83	970.71	97.36	873.36
89	3441.4	1202.7	0.13856	0.19287	1.3601	0.1593	0.03233	48.28	33.31	106.24	978.13	96.15	881.98
90	3487.4	1199.2	0.14013	0.19257	1.3622	0.1614	0.03278	48.56	33.39	106.71	986.88	96.61	890.28
91	3533.4	1189.4	0.14173	0.19135	1.3659	0.1651	0.03328	48.78	33.42	107.03	992.73	96.81	895.91
92	3579.7	1176.9	0.14336	0.18951	1.3681	0.1672	0.03378	48.39	33.25	107.51	1001.79	95.82	905.97
93	3626.2	1166.1	0.14495	0.18799	1.3721	0.1713	0.03429	48.62	33.29	107.77	1006.57	96.02	910.54
94	3673.2	1155.8	0.14658	0.18738	1.3746	0.1737	0.03479	48.47	33.20	108.21	1014.73	95.53	919.20
95	3720.7	1147.3	0.14820	0.18524	1.3779	0.1771	0.03530	48.68	33.24	108.53	1020.88	95.75	925.12
96	3768.6	1136.2	0.14980	0.18372	1.3814	0.1806	0.03581	48.73	33.21	108.83	1026.44	95.60	930.84
97	3816.6	1124.0	0.15138	0.18249	1.3851	0.1842	0.03633	48.74	33.17	109.09	1031.43	95.35	936.09
98	3865.4	1116.9	0.15296	0.18066	1.3872	0.1863	0.03681	48.75	33.15	109.52	1039.48	95.21	944.27
99	3914.2	1104.0	0.15457	0.17883	1.3900	0.1892	0.03733	48.45	33.00	109.87	1046.21	94.39	951.82
100	3963.7	1096.8	0.15615	0.17700	1.3931	0.1923	0.03783	48.71	33.06	110.17	1051.94	94.70	957.24
101	4013.4	1085.2	0.15776	0.17609	1.3958	0.1950	0.03834	48.48	32.94	110.52	1058.68	94.04	964.64
102	4063.4	1073.2	0.15935	0.17456	1.3991	0.1982	0.03887	48.37	32.86	110.80	1063.93	93.57	970.36
103	4113.8	1059.4	0.16092	0.17212	1.4029	0.2020	0.03940	48.25	32.77	110.99	1067.71	93.05	974.65

Elastic-Plastic Fracture Toughness Analysis

Specimen ID	5086-FT-2	**Geometry**	C(T)
Contract	SSC 10624-01	**Orientation**	T-L
Material	5086-H116	**Yield (ksi)**	27.0
Temperature(F)	75.0	**Tensile (ksi)**	46.0
Environment	LAB AIR	**Modulus (Msi)**	10.5

Specimen Dimensions

Thickness (in)	0.497	**Notch Depth (in)**	1.100
Net Thickness (in)	0.497	**Gage Length (in)**	0.200
Width (in)	2.000	**Alpha Ratio**	1
Pin Spacing (in)	1.100		

Precrack Parameters

Pmax (lbf)	308.4	**Stress Ratio**	0.1
Final a (in)	1.200	**Kmax (ksi sqrt (in))**	6.0
Pf (lbf)	885		

Initial measured crack lengths (in)

1.180	1.199	1.208	1.208	1.209	1.211	1.209	1.199	1.181

Final measured crack lengths (in)

1.331	1.362	1.446	1.577	1.636	1.514	1.405	1.349	1.338
x	x		x	x			x	x

Ave. initial crack length (in)	1.203	**aoq (in)**	n/a
Ave. final crack length (in)	1.453	**Compliance Adj. Factor**	1.014
Delta a measured (in)	0.250	**Effective Modulus (Msi)**	10.6
Delta a predicted (in)	0.198		

Results

J_Q (E1820)	147.6 lbf-in/in^2
$K_{JIC}(E'*JQ)^{1/2}$	41.3 ksi sqrt(in)

Qualification of Data

7.4.2: precrack length	valid
9.1.4.1; precrack	valid
9.1.4.2; final crack	invalid
9.1.5.1; Δa meas	valid
9.1.5.2; Δa pred	invalid
A9.6.4; # of pnts in reg.A	valid
A9.6.4; # of pnts in reg.B	valid
A9.8.1; C_2<1	valid
A9.8.2.1; a_{0q}-a_0	#VALUE!
A9.8.2.2; # of pnts for J_Q	valid
A9.8.2.2; # of pnts < J_Q	valid
A9.3.3.1; correlation	valid

Qualification of J_Q as J_{IC}

A9.9.1; thickness	valid
A9.9.2; ligament	valid
A9.9.3; slope	valid

Index	Time	Force	Disp1	Disp2	Crack	Δa	CTOD	K561	K1820	KJ1820	J1820	Je	Jpl
	Sec	lbf	inch	inch	inch	inch	inch	ksi sqr(in)	ksi sqr(in)	ksi sqr(in)	lbf/in	lbf/in	lbf/in
7	361.7	478.5	0.00561	0.07507	1.2031	0.0000	0.00010	9.56	9.36	9.37	7.61	7.60	0.01
9	439.8	719.3	0.00872	0.11322	1.2033	0.0002	0.00033	14.76	14.08	14.35	17.86	17.18	0.68
11	513.8	942.5	0.01185	0.14801	1.2037	0.0006	0.00065	20.05	18.46	19.26	32.14	29.54	2.60
12	550.5	1044.3	0.01341	0.16419	1.2043	0.0012	0.00085	22.69	20.48	21.65	40.64	36.34	4.29
13	586.8	1139.7	0.01498	0.17914	1.2043	0.0012	0.00107	25.27	22.35	24.04	50.11	43.29	6.81
14	622.6	1227.7	0.01658	0.19379	1.2042	0.0011	0.00132	27.78	24.07	26.43	60.54	50.21	10.33
15	658.1	1304.6	0.01815	0.20508	1.2045	0.0014	0.00159	30.14	25.59	28.72	71.48	56.78	14.71
16	693.5	1372.8	0.01974	0.21545	1.2052	0.0020	0.00188	32.37	26.97	30.98	83.21	63.02	20.18
17	728.3	1432.7	0.02133	0.22461	1.2056	0.0024	0.00218	34.42	28.16	33.20	95.52	68.75	26.77
18	763.1	1483.9	0.02294	0.23285	1.2063	0.0031	0.00249	36.30	29.21	35.38	108.46	73.96	34.50
19	797.5	1525.4	0.02455	0.23956	1.2074	0.0043	0.00282	37.96	30.10	37.47	121.70	78.51	43.19
20	831.6	1561.4	0.02615	0.24597	1.2082	0.0051	0.00315	39.43	30.86	39.51	135.26	82.51	52.74
21	865.8	1587.2	0.02778	0.24994	1.2100	0.0069	0.00350	40.69	31.48	41.48	149.13	85.88	63.26
22	899.8	1606.0	0.02941	0.25177	1.2121	0.0089	0.00385	41.76	31.98	43.39	163.17	88.65	74.52
23	933.8	1620.5	0.03102	0.25391	1.2141	0.0110	0.00420	42.67	32.40	45.21	177.16	90.99	86.17
24	968.1	1629.0	0.03265	0.25635	1.2164	0.0133	0.00457	43.40	32.72	46.98	191.32	92.81	98.51
25	1002.1	1640.3	0.03425	0.25818	1.2197	0.0165	0.00492	44.42	33.17	48.63	204.96	95.34	109.62
26	1036.4	1650.4	0.03588	0.25879	1.2213	0.0182	0.00528	45.16	33.48	50.33	219.52	97.16	122.36
27	1070.6	1656.7	0.03750	0.26001	1.2237	0.0205	0.00565	45.85	33.77	51.94	233.78	98.83	134.95
28	1104.7	1660.8	0.03913	0.25971	1.2244	0.0212	0.00603	46.17	33.90	53.59	248.94	99.60	149.34
29	1139.1	1663.8	0.04075	0.26123	1.2253	0.0221	0.00640	46.48	34.03	55.19	263.94	100.34	163.60
30	1173.2	1664.4	0.04236	0.26062	1.2281	0.0250	0.00677	47.03	34.24	56.62	277.83	101.58	176.25
31	1207.5	1664.3	0.04395	0.26184	1.2297	0.0266	0.00715	47.33	34.34	58.07	292.21	102.22	189.99
32	1242.1	1666.1	0.04557	0.26276	1.2316	0.0285	0.00752	47.77	34.51	59.49	306.73	103.24	203.49
33	1276.7	1670.4	0.04717	0.26306	1.2320	0.0289	0.00790	48.07	34.63	60.95	321.92	103.95	217.97
34	1311.4	1674.3	0.04881	0.26367	1.2337	0.0306	0.00828	48.61	34.84	62.33	336.65	105.19	231.46
35	1346.1	1675.7	0.05044	0.26367	1.2355	0.0324	0.00867	49.03	34.99	63.68	351.41	106.12	245.30
36	1380.7	1666.6	0.05206	0.26245	1.2358	0.0327	0.00906	48.63	34.83	65.06	366.86	105.12	261.74
37	1415.6	1666.0	0.05367	0.26215	1.2389	0.0358	0.00944	49.23	35.04	66.25	380.33	106.39	273.95
38	1450.7	1666.1	0.05530	0.26154	1.2396	0.0365	0.00983	49.38	35.09	67.57	395.67	106.72	288.95
39	1485.5	1650.7	0.05691	0.25971	1.2416	0.0385	0.01022	48.98	34.91	68.76	409.78	105.62	304.17
40	1520.6	1650.1	0.05852	0.25909	1.2436	0.0405	0.01061	49.37	35.05	69.93	423.78	106.44	317.34
41	1555.9	1650.1	0.06012	0.26184	1.2447	0.0415	0.01100	49.59	35.12	71.13	438.46	106.90	331.56
42	1591.2	1645.8	0.06172	0.25848	1.2463	0.0432	0.01139	49.70	35.15	72.27	452.65	107.07	345.58
43	1626.6	1642.5	0.06334	0.25757	1.2475	0.0443	0.01178	49.77	35.16	73.43	467.30	107.15	360.15
44	1662.4	1641.8	0.06495	0.25848	1.2492	0.0460	0.01217	50.10	35.27	74.53	481.39	107.84	373.55
45	1698.1	1643.5	0.06656	0.25787	1.2496	0.0464	0.01256	50.28	35.34	75.70	496.58	108.25	388.34
46	1733.9	1643.4	0.06817	0.25909	1.2517	0.0486	0.01295	50.75	35.50	76.73	510.25	109.23	401.02
47	1769.6	1635.9	0.06975	0.25665	1.2534	0.0503	0.01335	50.71	35.46	77.76	524.02	109.00	415.02
48	1805.2	1629.9	0.07135	0.25574	1.2550	0.0519	0.01374	50.73	35.46	78.78	537.95	108.95	429.00
49	1841.1	1622.0	0.07293	0.25574	1.2568	0.0536	0.01414	50.67	35.41	79.77	551.55	108.69	442.86
50	1877.2	1615.1	0.07456	0.25330	1.2586	0.0554	0.01455	50.69	35.40	80.77	565.41	108.60	456.81
51	1913.4	1607.2	0.07619	0.25269	1.2604	0.0573	0.01496	50.64	35.36	81.75	579.22	108.37	470.85
52	1949.6	1591.6	0.07778	0.24963	1.2630	0.0599	0.01537	50.35	35.22	82.63	591.70	107.50	484.20
53	1986	1588.1	0.07941	0.24963	1.2651	0.0620	0.01579	50.61	35.30	83.55	605.00	107.98	497.02
54	2022.6	1584.5	0.08102	0.24994	1.2668	0.0637	0.01619	50.80	35.35	84.47	618.45	108.29	510.16
55	2059.2	1579.9	0.08264	0.24841	1.2687	0.0656	0.01660	50.95	35.39	85.38	631.75	108.52	523.23
56	2095.9	1570.3	0.08425	0.24811	1.2711	0.0679	0.01702	50.94	35.35	86.23	644.40	108.32	536.08
57	2132.9	1563.1	0.08589	0.24689	1.2731	0.0700	0.01745	50.99	35.35	87.10	657.55	108.29	549.26
58	2170.1	1560.2	0.08749	0.24567	1.2749	0.0717	0.01785	51.22	35.42	87.96	670.54	108.72	561.82
59	2207.2	1550.8	0.08907	0.24384	1.2778	0.0747	0.01827	51.34	35.43	88.70	681.92	108.78	573.14
60	2244.7	1541.4	0.09066	0.24261	1.2797	0.0766	0.01869	51.23	35.37	89.52	694.60	108.40	586.20
61	2282.2	1534.6	0.09226	0.24261	1.2820	0.0789	0.01911	51.36	35.38	90.30	706.73	108.51	598.21
62	2319.9	1526.2	0.09388	0.24109	1.2841	0.0810	0.01954	51.36	35.36	91.10	719.20	108.36	610.84
63	2357.9	1513.7	0.09550	0.23865	1.2880	0.0849	0.01999	51.51	35.37	91.73	729.31	108.42	620.89
64	2395.9	1508.6	0.09712	0.23865	1.2895	0.0863	0.02041	51.55	35.37	92.55	742.40	108.42	633.98

Index	Time	Force	Disp1	Disp2	Crack	Δa	CTOD	K561	K1820	KJ1820	J1820	Je	Jpl
	Sec	lbf	inch	inch	inch	inch	inch	ksi sqr(in)	ksi sqr(in)	ksi sqr(in)	lbf/in	lbf/in	lbf/in
65	2434.1	1497.3	0.09874	0.23651	1.2923	0.0891	0.02085	51.52	35.32	93.25	753.68	108.14	645.54
66	2472.6	1490.5	0.10034	0.23590	1.2944	0.0913	0.02128	51.61	35.33	93.99	765.56	108.20	657.36
67	2510.9	1473.7	0.10196	0.23377	1.2975	0.0944	0.02173	51.29	35.18	94.64	776.19	107.25	668.94
68	2549.9	1460.3	0.10354	0.23071	1.3008	0.0977	0.02218	51.25	35.12	95.23	785.96	106.90	679.06
69	2588.9	1450.0	0.10515	0.23010	1.3039	0.1008	0.02263	51.36	35.12	95.84	796.09	106.92	689.16
70	2628.2	1440.3	0.10676	0.22858	1.3066	0.1034	0.02307	51.37	35.10	96.49	806.91	106.76	700.15
71	2667.7	1424.4	0.10836	0.22583	1.3097	0.1065	0.02353	51.09	34.96	97.08	816.73	105.91	710.82
72	2707.6	1414.3	0.10994	0.22430	1.3127	0.1095	0.02398	51.18	34.95	97.65	826.44	105.88	720.56
73	2747.7	1405.5	0.11156	0.22308	1.3151	0.1119	0.02443	51.19	34.93	98.29	837.32	105.73	731.59
74	2788.2	1396.6	0.11319	0.22186	1.3177	0.1146	0.02489	51.27	34.92	98.90	847.71	105.70	742.00
75	2828.7	1384.1	0.11479	0.22064	1.3208	0.1176	0.02535	51.18	34.86	99.45	857.24	105.29	751.94
76	2869.6	1371.9	0.11643	0.21820	1.3241	0.1210	0.02583	51.20	34.82	99.98	866.35	105.08	761.28
77	2910.4	1358.6	0.11808	0.21607	1.3267	0.1236	0.02630	50.95	34.70	100.58	876.67	104.35	772.32
78	2951.9	1344.8	0.11970	0.21393	1.3306	0.1275	0.02679	50.97	34.66	101.02	884.46	104.11	780.35
79	2993.4	1331.2	0.12131	0.21179	1.3334	0.1303	0.02726	50.74	34.54	101.56	893.87	103.39	790.48
80	3035.2	1320.7	0.12288	0.21027	1.3373	0.1341	0.02773	51.00	34.59	101.95	900.87	103.67	797.20
81	3077.7	1308.8	0.12452	0.20904	1.3402	0.1371	0.02822	50.91	34.52	102.47	910.00	103.26	806.74
82	3120.2	1298.7	0.12613	0.20691	1.3435	0.1403	0.02869	51.04	34.52	102.93	918.16	103.29	814.86
83	3163.1	1283.4	0.12773	0.20447	1.3471	0.1440	0.02919	50.89	34.42	103.34	925.45	102.69	822.76
84	3206.2	1274.9	0.12934	0.20325	1.3505	0.1474	0.02967	51.17	34.48	103.76	933.08	103.03	830.05
85	3249.9	1263.3	0.13091	0.20172	1.3541	0.1510	0.03015	51.26	34.47	104.14	939.98	102.95	837.03
86	3293.9	1258.7	0.13250	0.20142	1.3566	0.1535	0.03061	51.60	34.55	104.64	948.93	103.48	845.45
87	3338.2	1250.5	0.13410	0.20050	1.3581	0.1550	0.03107	51.38	34.46	105.23	959.75	102.90	856.86
88	3382.4	1240.5	0.13569	0.19867	1.3611	0.1580	0.03156	51.45	34.44	105.66	967.54	102.80	864.74
89	3427.2	1228.0	0.13728	0.19714	1.3642	0.1610	0.03205	51.32	34.36	106.07	975.07	102.30	872.77
90	3472.1	1208.8	0.13885	0.19348	1.3678	0.1647	0.03256	50.81	34.13	106.40	981.18	100.95	880.23
91	3517.7	1201.6	0.14047	0.19287	1.3716	0.1685	0.03306	51.30	34.25	106.73	987.17	101.69	885.48
92	3563.6	1190.6	0.14207	0.19073	1.3745	0.1714	0.03355	51.24	34.19	107.13	994.66	101.34	893.32
93	3609.6	1176.2	0.14367	0.18921	1.3785	0.1754	0.03407	51.21	34.13	107.41	999.80	100.95	898.85
94	3656.2	1168.5	0.14527	0.18860	1.3815	0.1783	0.03457	51.42	34.16	107.80	1007.10	101.16	905.95
95	3702.9	1145.6	0.14689	0.18494	1.3852	0.1821	0.03511	50.58	33.82	108.09	1012.65	99.14	913.51
96	3750.4	1137.8	0.14848	0.18311	1.3883	0.1852	0.03561	50.82	33.86	108.44	1019.08	99.39	919.69
97	3798.2	1129.3	0.15009	0.18189	1.3907	0.1876	0.03610	50.79	33.82	108.86	1027.05	99.14	927.91
98	3846.2	1117.6	0.15167	0.18005	1.3942	0.1910	0.03662	50.79	33.78	109.15	1032.48	98.87	933.62
99	3894.7	1097.6	0.15331	0.17761	1.3979	0.1948	0.03718	50.14	33.50	109.42	1037.64	97.27	940.37
100	3943.7	1087.7	0.15488	0.17609	1.4008	0.1977	0.03768	50.13	33.46	109.74	1043.70	97.02	946.68

Elastic-Plastic Fracture Toughness Analysis

Specimen ID	5086-FT-3	Geometry	C(T)
Contract	SSC 10624-01	Orientation	T-L
Material	5086-H116	Yield (ksi)	27.0
Temperature(F)	75.0	Tensile (ksi)	46.0
Environment	LAB AIR	Modulus (Msi)	10.5

Specimen Dimensions

Thickness (in)	0.496	Notch Depth (in)	1.100
Net Thickness (in)	0.396	Gage Length (in)	0.200
Width (in)	2.000	Alpha Ratio	1
Pin Spacing (in)	1.100		

Precrack Parameters

Pmax (lbf)	308.0	Stress Ratio	0.1
Final a (in)	1.200	Kmax (ksi sqrt (in))	6.1
Pf (lbf)	872		

Initial measured crack lengths (in)

1.187	1.204	1.208	1.207	1.210	1.213	1.215	1.213	1.207

Final measured crack lengths (in)

1.419	1.424	1.429	1.416	1.409	1.418	1.415	1.418	1.416

Ave. initial crack length (in)	1.208	aoq (in)	1.207
Ave. final crack length (in)	1.418	Compliance Adj. Factor	1.017
Delta a measured (in)	0.210	Effective Modulus (Msi)	10.7
Delta a predicted (in)	0.199		

Results

J_Q (E1820)	155.2 lbf-in/in^2
$K_{JIC}(E'*JQ)^{1/2}$	42.3 ksi sqrt(in)

Qualification of Data		Qualification of J_Q as J_{IC}	
7.4.2: precrack length	valid		
9.1.4.1; precrack	valid	A9.9.1; thickness	valid
9.1.4.2; final crack	valid	A9.9.2; ligament	valid
9.1.5.1; Δa meas	valid	A9.9.3; slope	valid
9.1.5.2; Δa pred	valid		
A9.6.4; # of pnts in reg.A	valid		
A9.6.4; # of pnts in reg.B	valid		
A9.8.1; C_2<1	valid		
A9.8.2.1; a_{0q}-a_0	valid		
A9.8.2.2; # of pnts for J_Q	valid		
A9.8.2.2; # of pnts < J_Q	valid		
A9.3.3.1; correlation	valid		

Index	Time	Force	Disp1	Disp2	Crack	Δa	CTOD	K561	K1820	KJ1820	J1820	Je	Jpl
	Sec	lbf	inch	inch	inch	inch	inch	ksi sqr(in)	ksi sqr(in)	ksi sqr(in)	lbf/in	lbf/in	lbf/in
10	342.7	304.1	0.00366	0.04822	1.2084	0.0011	0.00002	6.81	6.73	6.75	3.95	3.93	0.02
11	385.4	385.6	0.00471	0.06103	1.2080	0.0007	0.00007	8.68	8.53	8.57	6.36	6.31	0.05
12	418.3	464.9	0.00577	0.07294	1.2080	0.0007	0.00013	10.55	10.29	10.39	9.36	9.17	0.19
13	450.6	544.6	0.00682	0.08575	1.2071	-0.0002	0.00021	12.45	12.03	12.21	12.91	12.54	0.37
14	481.3	619.2	0.00787	0.09766	1.2065	-0.0008	0.00030	14.29	13.66	14.02	17.02	16.18	0.85
15	511.8	695.3	0.00894	0.10956	1.2079	0.0006	0.00040	16.29	15.38	15.80	21.65	20.51	1.14
16	542.1	766.5	0.00998	0.12085	1.2068	-0.0005	0.00052	18.13	16.92	17.60	26.85	24.81	2.04
17	571.8	836.3	0.01105	0.13214	1.2073	0.0000	0.00064	20.08	18.48	19.37	32.52	29.60	2.92
18	601.6	904.2	0.01211	0.14282	1.2081	0.0008	0.00078	22.08	20.01	21.13	38.71	34.72	4.00
19	631.1	969.8	0.01318	0.15350	1.2082	0.0008	0.00093	24.05	21.47	22.89	45.41	39.94	5.47
20	660.5	1031.7	0.01425	0.16296	1.2064	-0.0010	0.00110	25.86	22.75	24.70	52.87	44.87	8.00
21	689.5	1088.6	0.01532	0.17212	1.2083	0.0010	0.00126	27.85	24.10	26.38	60.32	50.34	9.98
22	718.6	1142.0	0.01639	0.17944	1.2071	-0.0002	0.00145	29.57	25.23	28.13	68.60	55.15	13.46
23	747.3	1191.7	0.01748	0.18738	1.2090	0.0017	0.00164	31.51	26.42	29.80	76.97	60.51	16.45
24	775.8	1236.6	0.01857	0.19501	1.2101	0.0028	0.00184	33.28	27.48	31.47	85.84	65.43	20.41
25	804.3	1277.0	0.01966	0.20111	1.2102	0.0029	0.00205	34.85	28.38	33.14	95.19	69.81	25.37
26	832.6	1313.6	0.02074	0.20691	1.2102	0.0029	0.00226	36.31	29.19	34.78	104.86	73.87	31.00
27	860.8	1347.7	0.02185	0.21240	1.2108	0.0035	0.00248	37.80	29.99	36.41	114.92	77.94	36.99
28	888.8	1375.7	0.02296	0.21698	1.2119	0.0045	0.00271	39.13	30.68	37.99	125.06	81.56	43.51
29	916.8	1399.5	0.02406	0.22125	1.2136	0.0063	0.00294	40.42	31.31	39.51	135.31	84.98	50.33
30	945	1420.4	0.02517	0.22308	1.2151	0.0077	0.00317	41.59	31.88	41.02	145.80	88.06	57.74
31	973	1433.9	0.02628	0.22491	1.2179	0.0105	0.00340	42.65	32.36	42.44	156.10	90.75	65.35
32	1000.8	1448.1	0.02739	0.22736	1.2205	0.0132	0.00364	43.76	32.85	43.83	166.51	93.54	72.97
33	1028.7	1456.8	0.02848	0.22949	1.2231	0.0158	0.00387	44.63	33.23	45.17	176.85	95.69	81.17
34	1057	1467.7	0.02960	0.23132	1.2261	0.0188	0.00411	45.72	33.68	46.49	187.34	98.32	89.02
35	1085	1476.4	0.03071	0.23193	1.2286	0.0212	0.00436	46.61	34.05	47.81	198.10	100.48	97.62
36	1112.9	1472.2	0.03181	0.23193	1.2334	0.0261	0.00460	47.29	34.29	48.98	207.95	101.90	106.05
37	1141.1	1468.2	0.03292	0.23163	1.2382	0.0308	0.00484	47.99	34.53	50.12	217.74	103.36	114.38
38	1169.4	1451.9	0.03402	0.22858	1.2440	0.0367	0.00509	48.22	34.57	51.18	227.02	103.57	123.45
39	1198.2	1450.2	0.03515	0.22766	1.2499	0.0425	0.00534	49.32	34.96	52.22	236.34	105.90	130.45
40	1227.2	1437.4	0.03625	0.22644	1.2561	0.0488	0.00559	49.87	35.10	53.20	245.28	106.80	138.48
41	1256.5	1420.9	0.03739	0.22400	1.2613	0.0540	0.00586	49.97	35.09	54.24	254.99	106.70	148.29
42	1286	1400.3	0.03853	0.22003	1.2694	0.0621	0.00612	50.46	35.19	55.08	262.97	107.31	155.66
43	1316	1371.5	0.03974	0.21576	1.2780	0.0706	0.00641	50.53	35.11	55.96	271.40	106.87	164.53
44	1346.4	1330.7	0.04098	0.20935	1.2892	0.0818	0.00671	50.37	34.93	56.68	278.42	105.72	172.70
45	1377.4	1316.1	0.04210	0.20721	1.2962	0.0889	0.00698	51.02	35.09	57.45	286.07	106.71	179.36
46	1408.6	1282.5	0.04320	0.20264	1.3052	0.0979	0.00725	50.81	34.90	58.08	292.33	105.58	186.75
47	1441.1	1264.5	0.04431	0.19928	1.3133	0.1059	0.00752	51.49	35.06	58.72	298.80	106.51	192.29
48	1473.7	1243.9	0.04544	0.19531	1.3213	0.1140	0.00780	51.99	35.14	59.36	305.35	106.99	198.36
49	1506.6	1201.8	0.04653	0.18921	1.3303	0.1229	0.00810	51.01	34.67	59.90	310.95	104.19	206.76
50	1541.1	1185.5	0.04766	0.18677	1.3380	0.1306	0.00838	51.74	34.84	60.49	317.13	105.19	211.94
51	1575.2	1152.9	0.04874	0.18189	1.3471	0.1398	0.00867	51.52	34.64	60.93	321.79	104.02	217.77
52	1610.5	1114.7	0.04992	0.17578	1.3584	0.1511	0.00899	51.34	34.44	61.30	325.66	102.78	222.89
53	1647.2	1115.6	0.05103	0.17578	1.3622	0.1549	0.00926	52.51	34.79	62.04	333.59	104.91	228.68
54	1683.7	1084.6	0.05214	0.17090	1.3708	0.1635	0.00957	52.20	34.57	62.47	338.20	103.58	234.62
55	1721.1	1051.9	0.05327	0.16510	1.3801	0.1728	0.00988	51.88	34.34	62.83	342.18	102.18	240.00
56	1758.9	1008.3	0.05435	0.15869	1.3909	0.1836	0.01021	50.90	33.85	63.04	344.38	99.32	245.06
57	1798.6	988.5	0.05543	0.15564	1.3987	0.1914	0.01051	51.27	33.87	63.40	348.34	99.45	248.90
58	1838.9	957.8	0.05652	0.15198	1.4079	0.2006	0.01083	50.96	33.64	63.65	351.12	98.10	253.03

Elastic-Plastic Fracture Toughness Analysis

Specimen ID	5086-FT-5	**Geometry**	C(T)
Contract	SSC 10624-01	**Orientation**	T-L
Material	5086-H116	**Yield (ksi)**	27.0
Temperature(F)	75.0	**Tensile (ksi)**	46.0
Environment	LAB AIR	**Modulus (Msi)**	10.5

Specimen Dimensions

Thickness (in)	0.497	**Notch Depth (in)**	2.200
Net Thickness (in)	0.497	**Gage Length (in)**	0.200
Width (in)	4.000	**Alpha Ratio**	1
Pin Spacing (in)	2.200		

Precrack Parameters

Pmax (lbf)	727.0	**Stress Ratio**	0.1
Final a (in)	2.400	**Kmax (ksi sqrt (in))**	9.9
Pf (lbf)	1811		

Initial measured crack lengths (in)

2.362	2.387	2.401	2.406	2.405	2.401	2.390	2.372	2.343

Final measured crack lengths (in)

2.510	2.552	2.633	2.727	2.784 x	2.690	2.574	2.522	2.504

Ave. initial crack length (in)	2.389	**aoq (in)**	2.389
Ave. final crack length (in)	2.624	**Compliance Adj. Factor**	0.991
Delta a measured (in)	0.234	**Effective Modulus (Msi)**	10.4
Delta a predicted (in)	0.218		

Results

J_Q (E1820)	201.0 lbf-in/in^2
K_{JIC}(E'*JQ)^1/2	48.2 ksi sqrt(in)

Qualification of Data

7.4.2: precrack length	valid
9.1.4.1; precrack	valid
9.1.4.2; final crack	invalid
9.1.5.1; Δa meas	valid
9.1.5.2; Δa pred	valid
A9.6.4; # of pnts in reg.A	valid
A9.6.4; # of pnts in reg.B	valid
A9.8.1; C_2<1	valid
A9.8.2.1; a_{0Q}-a_0	valid
A9.8.2.2; # of pnts for J_Q	valid
A9.8.2.2; # of pnts < J_Q	valid
A9.3.3.1; correlation	valid

Qualification of J_Q as J_{IC}

A9.9.1; thickness	valid
A9.9.2; ligament	valid
A9.9.3; slope	valid

Index	Time	Force	Disp1	Disp2	Crack	Δa	CTOD	K561	K1820	KJ1820	J1820	Je	Jpl
	Sec	lbf	inch	inch	inch	inch	inch	ksi sqr(in)	ksi sqr(in)	ksi sqr(in)	lbf/in	lbf/in	lbf/in
13	466.3	1883.2	0.02421	0.62164	2.3904	0.0013	0.00140	27.74	25.65	25.60	56.80	57.00	-0.20
14	498.2	2016.1	0.02637	0.66681	2.3919	0.0027	0.00168	30.11	27.49	28.01	67.99	65.51	2.48
15	529.8	2141.9	0.02853	0.70343	2.3911	0.0019	0.00199	32.34	29.19	30.41	80.15	73.82	6.33
16	561.1	2259.8	0.03071	0.74554	2.3923	0.0031	0.00231	34.59	30.83	32.75	92.97	82.37	10.60
17	592.3	2368.8	0.03289	0.78369	2.3924	0.0033	0.00266	36.70	32.32	35.07	106.59	90.53	16.06
18	623.8	2467.5	0.03507	0.81177	2.3929	0.0038	0.00303	38.69	33.68	37.34	120.86	98.33	22.53
19	655	2560.1	0.03727	0.84503	2.3948	0.0057	0.00341	40.71	35.01	39.56	135.60	106.24	29.36
20	686.1	2641.9	0.03943	0.87128	2.3964	0.0073	0.00380	42.54	36.19	41.70	150.71	113.50	37.21
21	717.3	2716.4	0.04162	0.89752	2.3965	0.0074	0.00422	44.18	37.21	43.85	166.68	120.01	46.67
22	748.6	2785.9	0.04383	0.91736	2.3963	0.0072	0.00466	45.73	38.16	45.99	183.32	126.19	57.14
23	779.6	2842.1	0.04604	0.94116	2.3989	0.0097	0.00510	47.20	39.02	48.03	199.89	131.97	67.92
24	810.5	2895.8	0.04826	0.95551	2.4017	0.0125	0.00554	48.67	39.87	50.02	216.82	137.77	79.06
25	841.1	2943.3	0.05045	0.97198	2.4019	0.0128	0.00600	49.84	40.53	52.00	234.38	142.40	91.98
26	871.8	2985.4	0.05264	0.98419	2.4049	0.0158	0.00645	51.13	41.24	53.87	251.53	147.37	104.16
27	902.8	3024.4	0.05485	0.99640	2.4049	0.0157	0.00693	52.11	41.77	55.81	269.94	151.23	118.71
28	933.6	3059.2	0.05705	1.00952	2.4069	0.0178	0.00740	53.18	42.34	57.64	287.89	155.35	132.54
29	964.1	3089.4	0.05923	1.02020	2.4093	0.0202	0.00787	54.18	42.86	59.40	305.82	159.19	146.63
30	995.1	3116.5	0.06146	1.03332	2.4109	0.0218	0.00836	55.05	43.30	61.19	324.49	162.50	161.99
31	1025.9	3138.9	0.06365	1.03882	2.4119	0.0228	0.00885	55.75	43.66	62.94	343.31	165.17	178.15
32	1057	3165.3	0.06586	1.04523	2.4143	0.0252	0.00934	56.70	44.13	64.62	361.89	168.75	193.13
33	1087.7	3187.6	0.06804	1.05194	2.4150	0.0259	0.00983	57.39	44.47	66.29	380.89	171.37	209.52
34	1118.6	3207.3	0.07024	1.06445	2.4173	0.0281	0.01032	58.17	44.84	67.92	399.78	174.27	225.51
35	1149.4	3219.8	0.07245	1.06415	2.4205	0.0314	0.01082	58.87	45.16	69.48	418.37	176.77	241.60
36	1180.2	3237.6	0.07466	1.07391	2.4217	0.0326	0.01132	59.51	45.47	71.08	437.91	179.17	258.74
37	1211.1	3248.3	0.07684	1.08093	2.4230	0.0338	0.01182	59.96	45.68	72.63	457.17	180.81	276.36
38	1242	3252.9	0.07907	1.07269	2.4257	0.0365	0.01233	60.39	45.86	74.14	476.39	182.29	294.10
39	1273	3267.8	0.08127	1.08307	2.4271	0.0380	0.01284	61.00	46.14	75.65	495.97	184.51	311.46
40	1304	3275.6	0.08350	1.08612	2.4306	0.0414	0.01335	61.62	46.41	77.08	514.92	186.66	328.26
41	1334.9	3286.4	0.08571	1.08490	2.4307	0.0416	0.01387	61.97	46.57	78.59	535.25	187.96	347.29
42	1366	3291.5	0.08794	1.09222	2.4322	0.0431	0.01439	62.30	46.71	80.04	555.26	189.10	366.16
43	1397.1	3297.1	0.09015	1.08734	2.4341	0.0450	0.01491	62.69	46.88	81.44	574.85	190.48	384.37
44	1428.1	3297.7	0.09236	1.08795	2.4369	0.0478	0.01543	63.04	47.02	82.79	594.07	191.62	402.45
45	1459.2	3291.6	0.09457	1.08643	2.4404	0.0512	0.01595	63.26	47.10	84.09	612.79	192.25	420.54
46	1490.5	3290.4	0.09680	1.08734	2.4429	0.0537	0.01649	63.52	47.20	85.42	632.32	193.07	439.25
47	1522.1	3294.2	0.09902	1.09192	2.4452	0.0560	0.01701	63.92	47.36	86.72	651.71	194.43	457.28
48	1553.6	3292.4	0.10123	1.09344	2.4490	0.0598	0.01754	64.33	47.52	87.94	670.21	195.70	474.51
49	1585.1	3284.3	0.10346	1.08398	2.4524	0.0633	0.01808	64.49	47.57	89.17	689.11	196.12	493.00
50	1616.6	3276.5	0.10569	1.08612	2.4565	0.0673	0.01862	64.75	47.65	90.35	707.51	196.81	510.70
51	1648.4	3277.9	0.10794	1.08337	2.4584	0.0692	0.01916	65.03	47.77	91.62	727.45	197.74	529.71
52	1680.1	3281.9	0.11017	1.08337	2.4611	0.0720	0.01969	65.52	47.96	92.82	746.60	199.34	547.27
53	1712.2	3280.5	0.11240	1.08307	2.4651	0.0760	0.02023	65.99	48.13	93.95	764.92	200.80	564.12
54	1744.1	3272.1	0.11460	1.08276	2.4687	0.0796	0.02077	66.18	48.19	95.07	783.27	201.26	582.01
55	1776.1	3265.8	0.11681	1.08215	2.4735	0.0844	0.02131	66.60	48.33	96.12	800.74	202.48	598.26
56	1808.1	3260.6	0.11903	1.08520	2.4765	0.0874	0.02186	66.82	48.41	97.25	819.59	203.09	616.50
57	1840.5	3246.8	0.12126	1.07056	2.4819	0.0927	0.02242	67.06	48.47	98.25	836.68	203.62	633.06
58	1872.9	3237.6	0.12347	1.07544	2.4857	0.0965	0.02297	67.26	48.52	99.31	854.74	204.07	650.67
59	1905.2	3226.2	0.12571	1.07117	2.4901	0.1009	0.02353	67.46	48.58	100.33	872.47	204.51	667.96
60	1937.7	3217.2	0.12794	1.06506	2.4952	0.1061	0.02409	67.85	48.70	101.30	889.38	205.55	683.83
61	1970.5	3213.4	0.13016	1.06506	2.4990	0.1099	0.02464	68.25	48.84	102.31	907.24	206.73	700.51
62	2003.2	3197.6	0.13238	1.05408	2.5040	0.1148	0.02521	68.38	48.85	103.26	924.16	206.86	717.30
63	2036.1	3182.8	0.13461	1.05072	2.5072	0.1180	0.02579	68.28	48.79	104.29	942.58	206.33	736.25
64	2068.9	3166.2	0.13683	1.04858	2.5144	0.1252	0.02636	68.71	48.91	105.10	957.26	207.33	749.93
65	2102.4	3161.0	0.13907	1.04553	2.5178	0.1286	0.02693	69.01	49.01	106.08	975.30	208.14	767.16
66	2135.9	3146.2	0.14127	1.04279	2.5226	0.1334	0.02750	69.15	49.03	106.97	991.70	208.32	783.38
67	2169.6	3130.8	0.14348	1.03394	2.5284	0.1393	0.02808	69.43	49.09	107.80	1007.17	208.89	798.28
68	2203.4	3118.0	0.14569	1.03455	2.5332	0.1441	0.02866	69.66	49.15	108.67	1023.38	209.34	814.04

Index	Time	Force	Disp1	Disp2	Crack	Δa	CTOD	K561	K1820	KJ1820	J1820	Je	Jpl
	Sec	lbf	inch	inch	inch	inch	inch	ksi sqr(in)	ksi sqr(in)	ksi sqr(in)	lbf/in	lbf/in	lbf/in
69	2237.2	3103.9	0.14789	1.02875	2.5358	0.1467	0.02923	69.49	49.06	109.63	1041.64	208.61	833.04
70	2271.2	3088.7	0.15012	1.01990	2.5427	0.1535	0.02982	69.93	49.18	110.38	1055.92	209.65	846.27
71	2305.2	3067.2	0.15229	1.01990	2.5467	0.1576	0.03041	69.69	49.06	111.23	1072.22	208.58	863.64
72	2339.4	3053.4	0.15452	1.01135	2.5519	0.1628	0.03100	69.95	49.12	112.03	1087.77	209.07	878.71
73	2373.9	3030.1	0.15677	0.99731	2.5582	0.1691	0.03161	69.97	49.08	112.78	1102.36	208.74	893.62
74	2408.7	3017.9	0.15900	1.00342	2.5630	0.1739	0.03221	70.23	49.14	113.58	1118.08	209.27	908.81
75	2443.6	2998.4	0.16124	0.99426	2.5682	0.1791	0.03282	70.24	49.10	114.36	1133.38	208.96	924.42
76	2478.6	2987.5	0.16347	0.98724	2.5729	0.1838	0.03342	70.54	49.18	115.14	1148.98	209.61	939.37
77	2513.9	2979.7	0.16572	0.98084	2.5773	0.1881	0.03401	70.92	49.29	115.94	1164.95	210.55	954.40
78	2549.1	2962.5	0.16793	0.98145	2.5818	0.1926	0.03462	70.91	49.25	116.71	1180.42	210.22	970.20
79	2584.4	2949.8	0.17013	0.97229	2.5881	0.1990	0.03522	71.42	49.39	117.35	1193.57	211.42	982.15
80	2620.2	2933.5	0.17234	0.96863	2.5931	0.2040	0.03583	71.53	49.39	118.08	1208.34	211.44	996.90
81	2655.9	2909.2	0.17455	0.96039	2.5987	0.2095	0.03646	71.39	49.29	118.75	1222.21	210.59	1011.62
82	2692.2	2895.2	0.17679	0.95306	2.6029	0.2138	0.03707	71.48	49.29	119.51	1237.82	210.58	1027.24
83	2728.7	2885.0	0.17899	0.95062	2.6080	0.2189	0.03768	71.90	49.41	120.18	1251.80	211.54	1040.26

Elastic-Plastic Fracture Toughness Analysis

Specimen ID	5383-FT-1	Geometry	C(T)
Contract	SSC 10624-01	Orientation	T-L
Material	5383-H116	Yield (ksi)	35.4
Temperature(F)	75.0	Tensile (ksi)	53.3
Environment	LAB AIR	Modulus (Msi)	10.5

Specimen Dimensions

Thickness (in)	0.487	Notch Depth (in)	1.100
Net Thickness (in)	0.487	Gage Length (in)	0.200
Width (in)	2.000	Alpha Ratio	1
Pin Spacing (in)	1.100		

Precrack Parameters

Pmax (lbf)	303.0	Stress Ratio	0.1
Final a (in)	1.200	Kmax (ksi sqrt (in))	6.0
Pf (lbf)	1060		

Initial measured crack lengths (in)

1.194	1.209	1.214	1.210	1.208	1.205	1.198	1.184	1.171

Final measured crack lengths (in)

1.303	1.349	1.482	1.592	1.630	1.544	1.426	1.332	1.326
x	x		x	x	x		x	x

Ave. initial crack length (in)	1.201	aoq (in)	n/a
Ave. final crack length (in)	1.459	Compliance Adj. Factor	1.003
Delta a measured (in)	0.258	Effective Modulus (Msi)	10.5
Delta a predicted (in)	0.204		

Results

J_Q (E1820)	86.6 lbf-in/in^2
K_{JIC}(E'*JQ)^1/2	31.6 ksi sqrt(in)

Qualification of Data

7.4.2: precrack length	valid
9.1.4.1; precrack	valid
9.1.4.2; final crack	invalid
9.1.5.1; Δa meas	valid
9.1.5.2; Δa pred	invalid
A9.6.4; # of pnts in reg.A	valid
A9.6.4; # of pnts in reg.B	valid
A9.8.1; C_2<1	valid
A9.8.2.1; a_{0q}-a_0	#VALUE!
A9.8.2.2; # of pnts for J_Q	valid
A9.8.2.2; # of pnts < J_Q	valid
A9.3.3.1; correlation	valid

Qualification of J_Q as J_{IC}

A9.9.1; thickness	valid
A9.9.2; ligament	valid
A9.9.3; slope	valid

Index	Time	Force	Disp1	Disp2	Crack	Δa	CTOD	K561	K1820	KJ1820	J1820	Je	Jpl
	Sec	lbf	inch	inch	inch	inch	inch	ksi sqr(in)	ksi sqr(in)	ksi sqr(in)	lbf/in	lbf/in	lbf/in
6	330.8	476.7	0.00582	0.07477	1.2014	0.0000	0.00009	9.62	9.48	9.48	7.79	7.79	0.01
7	371.7	597.2	0.00736	0.09369	1.2010	-0.0004	0.00017	12.14	11.87	11.95	12.39	12.20	0.18
8	410.7	716.7	0.00891	0.11292	1.2018	0.0004	0.00025	14.74	14.26	14.41	18.00	17.63	0.37
9	448.8	831.9	0.01046	0.13092	1.2026	0.0012	0.00036	17.34	16.58	16.85	24.60	23.83	0.77
10	486.3	945.3	0.01202	0.14893	1.2018	0.0004	0.00050	19.92	18.81	19.31	32.33	30.67	1.66
11	523.5	1053.5	0.01358	0.16602	1.2025	0.0011	0.00065	22.56	20.99	21.74	40.95	38.19	2.76
12	560.3	1158.8	0.01514	0.18219	1.2026	0.0012	0.00082	25.21	23.09	24.14	50.50	46.22	4.28
13	596.8	1257.3	0.01669	0.19806	1.2041	0.0027	0.00100	27.90	25.13	26.48	60.78	54.74	6.04
14	633.1	1350.1	0.01825	0.21362	1.2046	0.0032	0.00121	30.51	27.01	28.83	72.03	63.25	8.79
15	669	1434.8	0.01981	0.22553	1.2054	0.0040	0.00144	33.03	28.75	31.15	84.11	71.65	12.47
16	704.3	1493.8	0.02139	0.23498	1.2090	0.0076	0.00169	35.17	30.15	33.36	96.46	78.79	17.67
17	739.8	1553.5	0.02295	0.24475	1.2128	0.0114	0.00194	37.49	31.60	35.49	109.15	86.51	22.64
18	774.8	1574.3	0.02454	0.24750	1.2209	0.0195	0.00221	39.12	32.54	37.44	121.51	91.76	29.74
19	810.1	1603.1	0.02610	0.25238	1.2263	0.0249	0.00250	40.82	33.50	39.39	134.48	97.28	37.20
20	845.8	1617.0	0.02770	0.25574	1.2321	0.0307	0.00281	42.12	34.20	41.30	147.79	101.35	46.44
21	881.5	1636.1	0.02930	0.25757	1.2356	0.0342	0.00313	43.34	34.85	43.24	162.03	105.24	56.78
22	917.6	1656.8	0.03087	0.26001	1.2385	0.0371	0.00345	44.59	35.50	45.10	176.26	109.22	67.04
23	953.8	1666.4	0.03248	0.26459	1.2419	0.0405	0.00380	45.52	35.96	46.92	190.83	112.08	78.75
24	990	1687.5	0.03407	0.26489	1.2446	0.0432	0.00413	46.85	36.62	48.71	205.62	116.24	89.38
25	1026.1	1682.3	0.03566	0.26489	1.2480	0.0466	0.00449	47.19	36.77	50.41	220.20	117.16	103.03
26	1063	1696.6	0.03725	0.26672	1.2504	0.0490	0.00484	48.24	37.27	52.10	235.24	120.38	114.86
27	1099.2	1698.2	0.03884	0.26733	1.2536	0.0522	0.00519	48.89	37.55	53.71	249.98	122.23	127.75
28	1136.1	1706.4	0.04044	0.26886	1.2551	0.0537	0.00556	49.54	37.86	55.36	265.62	124.21	141.41
29	1172.7	1708.2	0.04204	0.26855	1.2576	0.0562	0.00593	50.10	38.10	56.92	280.82	125.81	155.01
30	1209.6	1708.7	0.04365	0.26764	1.2603	0.0588	0.00630	50.64	38.33	58.44	295.98	127.32	168.66
31	1246.6	1704.1	0.04527	0.26917	1.2628	0.0614	0.00669	50.93	38.44	59.94	311.41	128.03	183.38
32	1283.4	1699.4	0.04686	0.26703	1.2651	0.0637	0.00707	51.15	38.52	61.38	326.55	128.56	197.99
33	1320.6	1698.3	0.04845	0.26581	1.2671	0.0657	0.00745	51.52	38.66	62.80	341.77	129.53	212.24
34	1357.9	1685.9	0.05005	0.26520	1.2697	0.0683	0.00785	51.43	38.59	64.16	356.73	129.09	227.64
35	1395.4	1678.0	0.05163	0.26459	1.2721	0.0707	0.00824	51.53	38.61	65.47	371.51	129.20	242.30
36	1433.1	1665.2	0.05324	0.26215	1.2755	0.0741	0.00864	51.58	38.60	66.72	385.83	129.13	256.70
37	1470.9	1654.2	0.05483	0.26032	1.2792	0.0778	0.00903	51.80	38.66	67.89	399.50	129.52	269.97
38	1509	1638.5	0.05645	0.25726	1.2819	0.0805	0.00945	51.57	38.52	69.12	414.06	128.61	285.45
39	1546.9	1615.0	0.05804	0.25513	1.2840	0.0826	0.00987	50.79	38.14	70.33	428.72	126.09	302.62
40	1585.6	1610.4	0.05964	0.25360	1.2884	0.0869	0.01026	51.47	38.41	71.36	441.28	127.85	313.44
41	1624.5	1598.8	0.06122	0.25146	1.2917	0.0903	0.01066	51.58	38.42	72.41	454.44	127.92	326.52
42	1663.5	1581.6	0.06281	0.24841	1.2944	0.0930	0.01108	51.23	38.23	73.50	468.23	126.68	341.56
43	1702.7	1566.8	0.06441	0.24597	1.2982	0.0968	0.01150	51.27	38.21	74.48	480.78	126.51	354.27
44	1742.4	1528.5	0.06611	0.24078	1.3028	0.1014	0.01199	50.18	37.66	75.47	493.57	122.90	370.67
45	1782.5	1518.3	0.06768	0.23834	1.3065	0.1051	0.01239	50.42	37.73	76.36	505.37	123.37	382.00
46	1822.6	1491.8	0.06928	0.23498	1.3123	0.1109	0.01284	50.20	37.57	77.12	515.48	122.30	393.17
47	1863.1	1457.2	0.07084	0.22888	1.3188	0.1174	0.01329	49.67	37.25	77.77	524.12	120.27	403.85
48	1904.6	1445.9	0.07242	0.22766	1.3212	0.1198	0.01372	49.56	37.17	78.70	536.74	119.75	416.99
49	1946.2	1414.8	0.07405	0.22400	1.3279	0.1265	0.01419	49.23	36.95	79.31	545.19	118.32	426.87
50	1988.5	1395.1	0.07562	0.22034	1.3329	0.1314	0.01463	49.18	36.87	80.00	554.60	117.81	436.79
51	2031.4	1373.0	0.07729	0.21607	1.3377	0.1363	0.01510	48.95	36.71	80.73	564.79	116.80	447.98
52	2074.7	1351.2	0.07889	0.21271	1.3437	0.1423	0.01556	48.96	36.65	81.31	572.91	116.42	456.49
53	2118.6	1325.7	0.08048	0.20843	1.3486	0.1472	0.01603	48.53	36.40	81.94	581.83	114.81	467.01
54	2163.2	1312.6	0.08205	0.20660	1.3527	0.1513	0.01647	48.63	36.40	82.60	591.33	114.82	476.51
55	2208.1	1297.0	0.08362	0.20416	1.3580	0.1566	0.01692	48.85	36.44	83.15	599.18	115.08	484.10
56	2253.7	1275.9	0.08525	0.20294	1.3626	0.1612	0.01740	48.57	36.26	83.78	608.27	113.95	494.32
57	2299.7	1258.6	0.08685	0.19928	1.3672	0.1658	0.01787	48.52	36.18	84.36	616.81	113.47	503.33
58	2346.2	1237.9	0.08842	0.19562	1.3721	0.1707	0.01834	48.32	36.04	84.88	624.43	112.56	511.87
59	2393.4	1217.0	0.08998	0.19287	1.3764	0.1750	0.01882	47.95	35.82	85.44	632.64	111.20	521.44
60	2441.4	1200.9	0.09161	0.18982	1.3810	0.1796	0.01930	47.95	35.77	85.97	640.60	110.88	529.72
61	2489.9	1184.4	0.09323	0.18677	1.3854	0.1840	0.01979	47.87	35.68	86.52	648.74	110.35	538.39
62	2538.9	1152.2	0.09485	0.18280	1.3912	0.1898	0.02033	47.05	35.24	86.92	654.78	107.64	547.14
63	2588.7	1137.7	0.09644	0.18097	1.3962	0.1948	0.02080	47.22	35.26	87.34	661.15	107.77	553.38
64	2639.2	1113.1	0.09810	0.17731	1.4016	0.2002	0.02134	46.78	35.00	87.76	667.46	106.16	561.29
65	2690.9	1099.6	0.09970	0.17425	1.4050	0.2036	0.02183	46.63	34.89	88.31	675.86	105.50	570.36

Elastic-Plastic Fracture Toughness Analysis

Specimen ID	5383-FT-2	Geometry	C(T)
Contract	SSC 10624-01	Orientation	T-L
Material	5383-H116	Yield (ksi)	35.4
Temperature(F)	75.0	Tensile (ksi)	53.3
Environment	LAB AIR	Modulus (Msi)	10.5

Specimen Dimensions

Thickness (in)	0.487	Notch Depth (in)	1.100
Net Thickness (in)	0.487	Gage Length (in)	0.200
Width (in)	2.000	Alpha Ratio	1
Pin Spacing (in)	1.100		

Precrack Parameters

Pmax (lbf)	302.0	Stress Ratio	0.1
Final a (in)	1.200	Kmax (ksi sqrt (in))	6.0
Pf (lbf)	1057		

Initial measured crack lengths (in)

1.197	1.211	1.215	1.212	1.208	1.205	1.199	1.186	1.172

Final measured crack lengths (in)

1.301	1.371	1.500	1.629	1.652	1.558	1.408	1.320	1.291
x	x		x	x	x		x	x

Ave. initial crack length (in)	1.202	aoq (in)	n/a
Ave. final crack length (in)	1.467	Compliance Adj. Factor	1.009
Delta a measured (in)	0.264	Effective Modulus (Msi)	10.6
Delta a predicted (in)	0.206		

Results

J_Q (E1820)	86.1 lbf-in/in^2
$K_{JIC}(E'*JQ)^{1/2}$	31.5 ksi sqrt(in)

Qualification of Data

7.4.2: precrack length	valid
9.1.4.1; precrack	valid
9.1.4.2; final crack	invalid
9.1.5.1; Δa meas	invalid
9.1.5.2; Δa pred	invalid
A9.6.4; # of pnts in reg.A	valid
A9.6.4; # of pnts in reg.B	valid
A9.8.1; C_2<1	valid
A9.8.2.1; a_{0q}-a_0	#VALUE!
A9.8.2.2; # of pnts for J_Q	valid
A9.8.2.2; # of pnts < J_Q	valid
A9.3.3.1; correlation	valid

Qualification of J_Q as J_{IC}

A9.9.1; thickness	valid
A9.9.2; ligament	valid
A9.9.3; slope	valid

Index	Time	Force	Disp1	Disp2	Crack	Δa	CTOD	K561	K1820	KJ1820	J1820	Je	Jpl
	Sec	lbf	inch	inch	inch	inch	inch	ksi sqr(in)	ksi sqr(in)	ksi sqr(in)	lbf/in	lbf/in	lbf/in
8	417.2	477.1	0.00571	0.07568	1.2027	0.0000	0.00007	9.64	9.50	9.51	7.84	7.83	0.02
9	457.8	598.3	0.00725	0.09491	1.2025	-0.0003	0.00014	12.19	11.91	11.99	12.47	12.30	0.17
10	496.6	716.1	0.00878	0.11353	1.2024	-0.0003	0.00024	14.73	14.26	14.44	18.07	17.61	0.46
11	534.5	834.2	0.01034	0.13184	1.2023	-0.0005	0.00035	17.36	16.60	16.92	24.82	23.89	0.93
12	571.8	948.8	0.01190	0.15045	1.2029	0.0002	0.00048	20.04	18.91	19.37	32.53	30.98	1.55
13	609	1059.1	0.01347	0.16754	1.2026	-0.0001	0.00063	22.68	21.09	21.83	41.30	38.56	2.74
14	645.8	1165.0	0.01502	0.18402	1.2032	0.0005	0.00080	25.38	23.23	24.23	50.87	46.77	4.11
15	682.3	1266.5	0.01659	0.20019	1.2024	-0.0003	0.00100	28.00	25.21	26.66	61.61	55.09	6.53
16	718.6	1361.5	0.01814	0.21454	1.2044	0.0017	0.00120	30.78	27.21	28.98	72.79	64.17	8.62
17	754.5	1444.4	0.01970	0.22797	1.2050	0.0022	0.00143	33.24	28.90	31.31	84.95	72.38	12.57
18	790.1	1509.1	0.02127	0.23773	1.2084	0.0057	0.00167	35.55	30.40	33.53	97.44	80.10	17.34
19	825.8	1569.5	0.02286	0.24750	1.2116	0.0089	0.00193	37.83	31.82	35.72	110.60	87.75	22.85
20	860.5	1582.6	0.02448	0.24841	1.2195	0.0168	0.00223	39.19	32.60	37.74	123.43	92.08	31.35
21	896.1	1608.3	0.02620	0.25391	1.2264	0.0237	0.00254	40.97	33.59	39.84	137.56	97.78	39.77
22	932.1	1646.0	0.02782	0.26062	1.2296	0.0268	0.00284	42.79	34.60	41.87	151.90	103.75	48.16
23	967.6	1657.9	0.02943	0.26092	1.2341	0.0314	0.00317	43.92	35.18	43.77	166.06	107.25	58.80
24	1003.3	1665.8	0.03104	0.26215	1.2393	0.0366	0.00350	45.01	35.72	45.59	180.12	110.60	69.52
25	1039.5	1673.1	0.03265	0.26550	1.2429	0.0402	0.00385	45.89	36.15	47.40	194.74	113.28	81.46
26	1075.6	1683.8	0.03426	0.26520	1.2460	0.0432	0.00419	46.84	36.61	49.18	209.58	116.18	93.39
27	1112.1	1691.6	0.03587	0.26611	1.2485	0.0458	0.00455	47.61	36.98	50.93	224.78	118.51	106.28
28	1148.6	1701.1	0.03748	0.26733	1.2508	0.0481	0.00491	48.44	37.37	52.63	240.07	121.03	119.04
29	1185.2	1707.0	0.03909	0.26978	1.2531	0.0504	0.00527	49.13	37.68	54.29	255.40	123.07	132.33
30	1222.1	1710.2	0.04070	0.27039	1.2548	0.0521	0.00565	49.59	37.89	55.94	271.17	124.42	146.75
31	1258.7	1708.8	0.04229	0.26886	1.2587	0.0559	0.00601	50.25	38.17	57.41	285.62	126.25	159.37
32	1295.6	1705.8	0.04392	0.26855	1.2605	0.0578	0.00640	50.46	38.25	58.98	301.46	126.77	174.69
33	1332.9	1711.6	0.04552	0.27039	1.2620	0.0593	0.00677	51.05	38.51	60.50	317.21	128.50	188.71
34	1370.1	1709.0	0.04715	0.26855	1.2650	0.0623	0.00715	51.52	38.69	61.93	332.37	129.75	202.62
35	1407.5	1705.0	0.04877	0.26886	1.2675	0.0648	0.00754	51.83	38.81	63.34	347.71	130.53	217.18
36	1445.1	1695.6	0.05043	0.27008	1.2687	0.0660	0.00796	51.62	38.70	64.83	364.24	129.79	234.46
37	1482.6	1685.2	0.05201	0.26611	1.2726	0.0699	0.00834	51.91	38.79	66.03	377.91	130.40	247.51
38	1519.7	1667.8	0.05359	0.26337	1.2755	0.0728	0.00874	51.62	38.63	67.29	392.37	129.31	263.06
39	1557.7	1654.2	0.05520	0.26001	1.2788	0.0761	0.00914	51.63	38.59	68.48	406.45	129.08	277.38
40	1595.7	1639.3	0.05679	0.25757	1.2810	0.0783	0.00955	51.31	38.43	69.71	421.19	127.97	293.22
41	1634.1	1628.3	0.05838	0.25574	1.2846	0.0818	0.00995	51.50	38.47	70.81	434.53	128.28	306.26
42	1672.6	1607.7	0.05996	0.25421	1.2887	0.0860	0.01036	51.30	38.33	71.84	447.24	127.35	319.89
43	1711.6	1595.0	0.06157	0.25024	1.2921	0.0894	0.01077	51.36	38.32	72.90	460.56	127.28	333.28
44	1751	1574.6	0.06320	0.24811	1.2955	0.0928	0.01121	51.00	38.12	73.96	474.05	125.96	348.09
45	1790.6	1543.6	0.06487	0.24414	1.3012	0.0984	0.01167	50.54	37.85	74.85	485.59	124.18	361.41
46	1830.9	1533.5	0.06645	0.24200	1.3054	0.1026	0.01207	50.90	37.97	75.75	497.29	124.93	372.35
47	1871.1	1514.4	0.06804	0.23895	1.3089	0.1062	0.01250	50.62	37.80	76.68	509.57	123.84	385.72
48	1912	1491.7	0.06968	0.23438	1.3131	0.1104	0.01295	50.26	37.59	77.57	521.53	122.48	399.05
49	1953.1	1472.0	0.07129	0.23163	1.3173	0.1146	0.01339	50.08	37.46	78.41	532.81	121.64	411.16
50	1994.5	1461.6	0.07287	0.23041	1.3210	0.1183	0.01381	50.29	37.52	79.25	544.26	121.99	422.27
51	2036.1	1442.6	0.07448	0.22827	1.3254	0.1227	0.01425	50.17	37.42	80.02	554.98	121.32	433.66
52	2078.1	1407.2	0.07616	0.22247	1.3309	0.1282	0.01476	49.35	36.98	80.74	564.96	118.51	446.45
53	2120.9	1389.8	0.07773	0.21942	1.3348	0.1321	0.01520	49.20	36.86	81.47	575.30	117.78	457.52
54	2164.1	1364.1	0.07934	0.21515	1.3406	0.1379	0.01567	48.95	36.69	82.07	583.74	116.67	467.08
55	2207.9	1342.6	0.08095	0.21210	1.3458	0.1431	0.01613	48.81	36.56	82.69	592.64	115.87	476.77
56	2252.4	1325.8	0.08256	0.20966	1.3500	0.1473	0.01659	48.74	36.49	83.37	602.32	115.37	486.95
57	2296.9	1298.4	0.08416	0.20538	1.3561	0.1534	0.01707	48.41	36.27	83.86	609.42	114.01	495.41
58	2342.4	1267.2	0.08574	0.20111	1.3620	0.1593	0.01757	47.80	35.92	84.34	616.43	111.83	504.60
59	2388.9	1253.4	0.08732	0.19897	1.3662	0.1635	0.01802	47.87	35.91	84.92	625.06	111.74	513.32
60	2435.4	1235.5	0.08892	0.19653	1.3702	0.1675	0.01850	47.63	35.75	85.53	634.00	110.78	523.22
61	2482.4	1216.4	0.09048	0.19226	1.3753	0.1726	0.01897	47.55	35.66	86.00	640.97	110.22	530.75
62	2530.1	1181.5	0.09215	0.18829	1.3827	0.1800	0.01952	46.96	35.30	86.31	645.56	108.02	537.54
63	2578.6	1151.4	0.09370	0.18280	1.3900	0.1873	0.02002	46.61	35.06	86.54	649.03	106.55	542.47
64	2628.4	1135.1	0.09528	0.18005	1.3953	0.1926	0.02050	46.71	35.05	86.94	655.05	106.47	548.58
65	2678.4	1110.7	0.09687	0.17731	1.4010	0.1983	0.02101	46.36	34.82	87.28	660.28	105.10	555.19
66	2729.4	1079.1	0.09844	0.17273	1.4087	0.2060	0.02155	45.93	34.54	87.43	662.45	103.38	559.07

Elastic-Plastic Fracture Toughness Analysis

Specimen ID	5383-FT-3	**Geometry**	C(T)
Contract	SSC 10624-01	**Orientation**	T-L
Material	5383-H116	**Yield (ksi)**	35.4
Temperature(F)	75.0	**Tensile (ksi)**	53.3
Environment	LAB AIR	**Modulus (Msi)**	10.5

Specimen Dimensions

Thickness (in)	0.484	**Notch Depth (in)**	1.100
Net Thickness (in)	0.377	**Gage Length (in)**	0.200
Width (in)	2.000	**Alpha Ratio**	1
Pin Spacing (in)	1.100		

Precrack Parameters

Pmax (lbf)	300.9	**Stress Ratio**	0.1
Final a (in)	1.200	**Kmax (ksi sqrt (in))**	6.1
Pf (lbf)	1044		

Initial measured crack lengths (in)

1.196	1.202	1.205	1.204	1.204	1.206	1.208	1.205	1.204

Final measured crack lengths (in)

1.388	1.407	1.414	1.414	1.426	1.420	1.419	1.410	1.391

Ave. initial crack length (in)	1.204	**aoq (in)**	1.205
Ave. final crack length (in)	1.413	**Compliance Adj. Factor**	1.027
Delta a measured (in)	0.208	**Effective Modulus (Msi)**	10.8
Delta a predicted (in)	0.202		

Results

J_Q (E1820)	90.3 lbf-in/in^2
K_{JIC}(E*JQ)^1/2	32.3 ksi sqrt(in)

Qualification of Data

7.4.2: precrack length	valid
9.1.4.1; precrack	valid
9.1.4.2; final crack	valid
9.1.5.1; Δa meas	valid
9.1.5.2; Δa pred	valid
A9.6.4; # of pnts in reg.A	valid
A9.6.4; # of pnts in reg.B	valid
A9.8.1; C_2<1	valid
A9.8.2.1; a_{0q}-a_0	valid
A9.8.2.2; # of pnts for J_Q	invalid
A9.8.2.2; # of pnts < J_Q	valid
A9.3.3.1; correlation	valid

Qualification of J_Q as J_{IC}

A9.9.1; thickness	valid
A9.9.2; ligament	valid
A9.9.3; slope	valid

Index	Time	Force	Disp1	Disp2	Crack	Δa	CTOD	K561	K1820	KJ1820	J1820	Je	Jpl
	Sec	lbf	inch	inch	inch	inch	inch	ksi sqr(in)	ksi sqr(in)	ksi sqr(in)	lbf/in	lbf/in	lbf/in
4	173.2	302.6	0.00378	0.04883	1.2045	-0.0005	0.00003	6.96	6.90	6.91	4.14	4.13	0.01
5	279.4	423.1	0.00534	0.06744	1.2038	-0.0012	0.00009	9.79	9.64	9.67	8.11	8.06	0.05
6	314.3	538.2	0.00687	0.08575	1.2040	-0.0010	0.00017	12.57	12.27	12.36	13.24	13.04	0.19
7	347.8	651.3	0.00841	0.10376	1.2035	-0.0016	0.00027	15.37	14.83	15.06	19.67	19.06	0.61
8	380.8	761.9	0.00996	0.12116	1.2040	-0.0010	0.00040	18.24	17.37	17.74	27.28	26.14	1.13
9	413.6	869.3	0.01150	0.13916	1.2031	-0.0020	0.00055	21.08	19.78	20.44	36.20	33.91	2.29
10	445.8	974.9	0.01306	0.15442	1.2041	-0.0009	0.00072	24.11	22.23	23.09	46.20	42.82	3.38
11	477.8	1074.2	0.01462	0.17029	1.2040	-0.0010	0.00091	27.04	24.49	25.76	57.49	51.97	5.52
12	509.3	1165.8	0.01618	0.18616	1.2054	0.0004	0.00112	29.99	26.65	28.34	69.60	61.54	8.05
13	540.6	1246.2	0.01774	0.19775	1.2085	0.0035	0.00134	32.92	28.66	30.86	82.54	71.20	11.33
14	571.1	1288.9	0.01931	0.20386	1.2185	0.0135	0.00158	35.39	30.24	33.13	95.10	79.27	15.82
15	601.8	1307.4	0.02089	0.20630	1.2341	0.0291	0.00181	37.81	31.67	35.13	106.97	86.91	20.06
16	631.3	1248.3	0.02243	0.19775	1.2628	0.0578	0.00204	38.87	32.11	36.51	115.53	89.38	26.15
17	663.5	1226.8	0.02399	0.19470	1.2845	0.0794	0.00227	40.84	33.09	38.02	125.28	94.88	30.40
18	696.1	1158.3	0.02554	0.18372	1.3130	0.1080	0.00252	41.69	33.33	39.14	132.74	96.27	36.47
19	730.8	1103.4	0.02709	0.17487	1.3374	0.1324	0.00279	42.64	33.62	40.27	140.57	97.98	42.58
20	766.3	995.5	0.02868	0.15808	1.3770	0.1720	0.00303	43.07	33.48	40.64	143.16	97.12	46.04
21	806	911.6	0.03024	0.14587	1.4063	0.2013	0.00334	42.90	33.10	41.27	147.65	94.98	52.67

Elastic-Plastic Fracture Toughness Analysis

Specimen ID	5383-FT-5	Geometry	C(T)
Contract	SSC 10624-01	Orientation	T-L
Material	5383-H116	Yield (ksi)	35.4
Temperature(F)	75.0	Tensile (ksi)	53.3
Environment	LAB AIR	Modulus (Msi)	10.5

Specimen Dimensions

Thickness (in)	0.485	Notch Depth (in)	2.200
Net Thickness (in)	0.485	Gage Length (in)	0.200
Width (in)	4.000	Alpha Ratio	1
Pin Spacing (in)	2.200		

Precrack Parameters

Pmax (lbf)	710.2	Stress Ratio	0.1
Final a (in)	2.400	Kmax (ksi sqrt (in))	9.9
Pf (lbf)	2148		

Initial measured crack lengths (in)

2.338	2.370	2.387	2.398	2.402	2.407	2.405	2.394	2.375

Final measured crack lengths (in)

2.475	2.495	2.587	2.729	2.825	2.713	2.579	2.526	2.503
x				x				

Ave. initial crack length (in)	2.390	aoq (in)	2.394
Ave. final crack length (in)	2.618	Compliance Adj. Factor	0.975
Delta a measured (in)	0.228	Effective Modulus (Msi)	10.2
Delta a predicted (in)	0.211		

Results

J_Q (E1820)	99.9 lbf-in/in^2
K_{JIC}(E'*JQ)^1/2	34.0 ksi sqrt(in)

Qualification of Data

7.4.2: precrack length	valid
9.1.4.1; precrack	valid
9.1.4.2; final crack	invalid
9.1.5.1; Δa meas	valid
9.1.5.2; Δa pred	valid
A9.6.4; # of pnts in reg.A	valid
A9.6.4; # of pnts in reg.B	valid
A9.8.1; C_2<1	valid
A9.8.2.1; a_{0q}-a_0	valid
A9.8.2.2; # of pnts for J_Q	valid
A9.8.2.2; # of pnts < J_Q	invalid
A9.3.3.1; correlation	valid

Qualification of J_Q as J_{IC}

A9.9.1; thickness	valid
A9.9.2; ligament	valid
A9.9.3; slope	valid

Index	Time	Force	Disp1	Disp2	Crack	Δa	CTOD	K561	K1820	KJ1820	J1820	Je	Jpl
	Sec	lbf	inch	inch	inch	inch	inch	ksi sqr(in)	ksi sqr(in)	ksi sqr(in)	lbf/in	lbf/in	lbf/in
18	637.1	2303.0	0.03057	0.75714	2.3911	-0.0026	0.00164	34.94	32.13	32.08	89.19	89.46	-0.27
19	669.1	2418.5	0.03275	0.79742	2.3943	0.0006	0.00192	37.16	33.85	34.46	102.89	99.28	3.61
20	701.1	2518.9	0.03490	0.82825	2.3993	0.0056	0.00221	39.27	35.42	36.72	116.86	108.75	8.11
21	733.1	2608.8	0.03709	0.86243	2.4047	0.0110	0.00252	41.28	36.88	38.98	131.66	117.89	13.76
22	765.1	2694.6	0.03925	0.89172	2.4091	0.0154	0.00285	43.22	38.26	41.16	146.85	126.86	20.00
23	797.6	2779.5	0.04143	0.92651	2.4121	0.0184	0.00319	45.13	39.58	43.36	162.94	135.79	27.15
24	830	2864.1	0.04358	0.94604	2.4143	0.0206	0.00354	47.04	40.88	45.51	179.52	144.81	34.70
25	862.3	2936.1	0.04578	0.96985	2.4171	0.0235	0.00392	48.78	42.02	47.65	196.75	153.04	43.71
26	894.6	3003.2	0.04794	0.98908	2.4211	0.0274	0.00429	50.55	43.15	49.68	213.93	161.37	52.56
27	926.8	3073.1	0.05013	1.01349	2.4234	0.0297	0.00469	52.31	44.26	51.76	232.17	169.75	62.42
28	959	3135.5	0.05231	1.03882	2.4246	0.0310	0.00510	53.87	45.21	53.81	250.95	177.16	73.78
29	991.3	3193.5	0.05449	1.05621	2.4278	0.0341	0.00550	55.51	46.19	55.78	269.61	184.93	84.68
30	1023.6	3244.5	0.05666	1.07269	2.4294	0.0357	0.00592	56.89	47.00	57.74	288.97	191.49	97.48
31	1056	3291.0	0.05884	1.08765	2.4330	0.0393	0.00635	58.38	47.85	59.63	308.20	198.44	109.76
32	1088.5	3330.1	0.06104	1.10413	2.4353	0.0416	0.00679	59.59	48.53	61.54	328.26	204.13	124.13
33	1120.9	3365.9	0.06321	1.11115	2.4397	0.0460	0.00723	60.95	49.27	63.33	347.61	210.40	137.21
34	1153.2	3391.0	0.06540	1.12610	2.4434	0.0497	0.00768	62.00	49.82	65.13	367.62	215.15	152.46
35	1185.6	3395.2	0.06763	1.12457	2.4470	0.0533	0.00818	62.48	50.07	66.93	388.21	217.27	170.94
36	1218.2	3421.0	0.06982	1.12976	2.4526	0.0590	0.00863	63.79	50.74	68.58	407.64	223.12	184.52
37	1250.6	3427.4	0.07200	1.13892	2.4585	0.0648	0.00909	64.61	51.14	70.19	426.96	226.65	200.32
38	1283.4	3439.8	0.07423	1.13739	2.4641	0.0705	0.00957	65.60	51.62	71.81	446.97	230.93	216.04
39	1316.2	3447.3	0.07645	1.14563	2.4689	0.0753	0.01006	66.37	51.99	73.43	467.25	234.23	233.02
40	1349.2	3438.9	0.07867	1.13647	2.4766	0.0830	0.01055	67.03	52.27	74.91	486.37	236.82	249.55
41	1382.6	3437.8	0.08094	1.14319	2.4832	0.0895	0.01106	67.79	52.61	76.43	506.31	239.91	266.41
42	1415.9	3437.6	0.08315	1.13800	2.4899	0.0963	0.01155	68.63	52.98	77.87	525.51	243.30	282.21
43	1449.5	3433.2	0.08534	1.13983	2.4950	0.1013	0.01205	69.12	53.19	79.33	545.45	245.23	300.22
44	1483.1	3425.9	0.08755	1.14105	2.5019	0.1082	0.01256	69.78	53.47	80.71	564.50	247.76	316.74
45	1517	3406.5	0.08978	1.13159	2.5086	0.1149	0.01309	70.04	53.54	82.08	583.84	248.46	335.38
46	1551	3380.1	0.09194	1.11633	2.5187	0.1250	0.01359	70.52	53.70	83.24	600.44	249.93	350.51
47	1585.6	3365.8	0.09411	1.11389	2.5267	0.1331	0.01409	71.14	53.94	84.44	617.99	252.12	365.87
48	1620.5	3342.6	0.09631	1.10779	2.5352	0.1415	0.01462	71.52	54.05	85.63	635.53	253.22	382.30
49	1655.6	3326.0	0.09851	1.10413	2.5419	0.1482	0.01515	71.89	54.18	86.87	654.04	254.37	399.67
50	1690.9	3304.4	0.10072	1.09406	2.5490	0.1554	0.01569	72.16	54.25	88.07	672.18	255.03	417.15
51	1726.1	3264.0	0.10290	1.08246	2.5610	0.1674	0.01623	72.46	54.29	89.02	686.75	255.46	431.28
52	1762.1	3233.3	0.10513	1.07056	2.5695	0.1759	0.01679	72.59	54.29	90.12	703.82	255.43	448.39
53	1798.5	3220.7	0.10734	1.06415	2.5767	0.1830	0.01732	73.20	54.51	91.23	721.29	257.50	463.79
54	1834.6	3183.1	0.10953	1.05072	2.5859	0.1922	0.01789	73.18	54.43	92.22	737.12	256.72	480.40
55	1871.5	3158.0	0.11175	1.04706	2.5937	0.2000	0.01845	73.42	54.47	93.27	753.92	257.17	496.75
56	1908.6	3139.3	0.11395	1.04065	2.6025	0.2088	0.01899	74.08	54.69	94.23	769.50	259.25	510.24

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(U) The Ship Structure Committee (SSC) identified a lack of information required for structural integrity and damage tolerance analyses of aluminum marine structures. The development of such data is vital in light of the increased use of aluminum alloys in marine construction. Under SSC project SR–1447, Fracture Technology Associates was contracted to characterize, through experimental fracture mechanics, the fatigue crack growth (FCG) resistance and fracture toughness of three aluminum alloys (5083, 5086, 5383) used in marine structural applications. Fatigue crack growth testing was performed following ASTM Standard E 647–00 in laboratory air at room temperature and in simulated ocean water per ASTM Standard D 1141. Non–linear fracture toughness testing was performed in accordance with ASTM Standard E 1820–01 in laboratory air at room temperature. For the three different grades of material, the difference in fatigue crack growth rate in laboratory air was negligible. In simulated seawater environment, AA5086 showed a slightly superior performance. In addition, all samples showed the same ranking of toughness with the 5086 showing the highest toughness, followed by 5083 and then 5383.

(U) Le Comité sur la structure des navires (CSN) a identifié des lacunes dans l'information requise pour l'analyse de l'intégrité structurale et de la tolérance aux avaries des structures maritimes en aluminium. Le développement de ces données est vital en ce sens que l'on utilise de plus en plus les alliages d'aluminium dans la construction maritime. Dans le cadre du projet SR–1447 du SSC, on a donné un contrat à la société Fracture Technology Associates pour qu'elle caractérise, grâce à des expériences de mécanique de la rupture, la résistance à la propagation des fissures en fatigue (PFF) et la ténacité (résistance à la propagation brutale de fissures) de trois alliages d'aluminium (5083, 5086, 5383) utilisés dans des applications structurales maritimes. Des essais sur la propagation des fissures en fatigue ont été réalisés, conformément à la norme ASTM Standard E 647–00, hors de l'eau et en laboratoire, à la température ambiante, ainsi que dans un milieu marin simulé en suivant la norme ASTM Standard D 1141. Des essais sur la résistance à la propagation de fissures non linéaires ont été réalisés, conformément à la norme ASTM Standard E 1820–01, hors de l'eau et en laboratoire, à la température ambiante. Pour les trois nuances d'alliages différentes, la différence dans le taux de propagation des fissures en laboratoire et hors de l'eau était négligeable. Dans le milieu marin simulé, l'alliage AA5086 a démontré une performance légèrement supérieure. En outre, tous les échantillons se sont situés à l'intérieur de la même plage de ténacité, l'alliage 5086 étant le plus résistant, suivi de l'alliage 5083, puis de l'alliage 5383.

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(U) Fracture crack growth, fracture toughness, aluminum, marine

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